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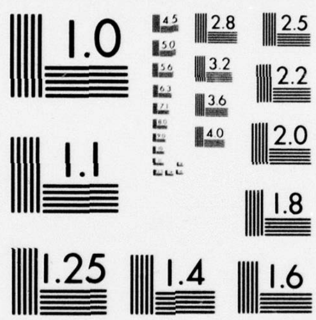

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TECHNICAL REPORT ARBRL-TR-02123

HIGHLY SURVIVABLE TRUSS TYPE TAIL BOOM

Thomas F. Erline

November 1978

US ARMY ARMAMENT RESEARCH AND DEVELOPMENT COMMAND
BALLISTIC RESEARCH LABORATORY
ABERDEEN PROVING GROUND, MARYLAND

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Airframes	Helicopters	Truss
Tail Boom	Survivable	Design
Vulnerability Reduction	Semimonocoque	Anti-Aircraft
30mm HEI	23mm HEI	Threat
Structural Integrity	Highly Redundant	Substructured

20. ABSTRACT (*Continue on reverse side if necessary and identify by block number*)

Highly redundant truss type structures, which are lightweight, have been analyzed by NASTRAN for replacement of the semimonocoque type tail boom. Analyses show that even with massive damage criterion imposed the structure retains its integrity with level flight loads up to 130 knots. The truss presents itself as a structural challenge to Soviet AA threat of the 23mm and 30mm HEI rounds.

Comparing the vulnerable semimonocoque configuration with the truss structure: semimonocoque's vulnerable area is nearly 100% of the present area; the → (over)

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truss has a greatly reduced vulnerable area (the joints are most vulnerable and their areas are small). The semimonocoque is blast sensitive to the AA threats mentioned because the detonation is confined and a large surface area is blown away; the truss does not confine the blast, thus is less sensitive. Since the thin skin structure of the semimonocoque carries a great deal of load it is sensitive to crack propagation; the truss is insensitive to crack propagation. Since the truss can be easily designed lightweight, the truss presents itself as a highly survivable competitive alternate for future Army helicopters.

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I. INTRODUCTION

Successful completion of Army helicopter missions in future battle scenarios may well depend upon survival of the structure after battle damage. Survivability of a helicopter will depend significantly upon the structure's ability to retain structural integrity. The principal purpose of this study is to develop a structural concept which assures a high degree of confidence in the integrity of a structure that has received combat damage. This study has been pursued because the Army needs to meet and provide a solution to the ever escalating high explosive anti-aircraft threat to the helicopter tail boom.

The highly lethal 23mm high explosive projectile represents an existing widely deployed threat to Army helicopters. The more lethal 30mm high explosive projectile appears on the horizon as the potential future threat. Because of this potentially severe 30mm threat and the possible inadequacy of present semimonocoque designs to survive hits by the 30mm, the present study was initiated to develop a structural challenge to the 30mm and to improve upon the present designs.

The tail boom of a helicopter (for example, the present AH-1 and UH-1 models) presents a significant amount of vulnerable area, and due to the flight loads of the tail rotor and elevators, the tail boom is constantly in some stressed condition. The semimonocoque tail boom construction configuration consists of skins, longerons, stringers, and bulkheads. Four longerons provide the main bending support for the tail boom. Shear loads are carried by the skin structure which is locally supported against buckling by the stringers. Presently the semimonocoque structure is configured to a minimum weight design. Ballistics tests using the 23mm high explosive against the minimum weight semimonocoque tail boom design have demonstrated its lack of damage tolerance[1]. Structural modifications have been shown to increase the damage tolerance of the structure but the amount of damage is predictably a function of confined volume and detonation distance to the surface[1]. Clearly the larger 30mm projectile reduces the survivability of the entire semimonocoque tail boom structure.

The solution for a structural challenge in this study took the form of a search for a highly redundant tail boom structure. A highly redundant structure is a structure that starts with a compact unit structure. The compact unit structure is interconnected within itself by comparatively small, relative to the entire structure, but stiff structural elements. The entire structure is then built up by a replication of the unit structure, scaling as desired or necessitated. The main reason for a high degree of redundancy is to build up damage tolerance by attempting to keep damage strictly localized.

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[1]D.F. Haskell, Damage Tolerance of Semimonocoque Aircraft, Paper at 41st Meeting of NATO-AGARD Impact Damage Tolerance of Structures Conference, Ankara, Turkey, October 1975.

A possible engineering solution that can easily be made highly redundant is the truss type structure. Use of modern technology and standard elements can make a truss both practical and economical. Because of its potential to fulfill such characteristics, the truss type structure was selected for this study in place of the semimonocoque structure. This study not only utilizes the truss concept but also introduces the concept of complete imbedded substructures. Complete imbedded substructures are easily generated within a truss structure that has a base figure equivalent to a quadrilateral by including the interior diagonals in a simple open truss structure. The intent is to develop a truss type tail boom with complete substructures that is highly redundant so that it can absorb massive damage and yet still hold the aerodynamic loads of flight. The truss tail boom can reduce vulnerability while lowering the weight of the tail boom. The observable surface area drops significantly reducing visibility and radar echo. A bonus would be the possibility of mounting a recoilless rifle on the helicopter because the openness of the truss allows the passage of back blast.

The development was performed throughout by computer modeling. The aerodynamic loads can be simulated and a damage criterion established very easily by this technique. A damage criterion should reflect a maximum amount of damage that can be sustained by the structure. The design objective is to retain structural integrity after imposition of the damage criterion.

Damage to a truss structure would not be in terms of confined volume or surface distance as it is in the semimonocoque structure, but damage would be in terms of loss of a member(s) or a loss of a joint. Not counting a completely destructive blast, the most catastrophic single event that could occur to a truss structure would be the destruction of a joint. The loss of a joint in a truss structure can be considered as massive damage because the loss of many members assembled at the joint is associated with loss of the joint. The demand that the truss sustain loss of a single joint and still retain structural integrity (not have other members buckle or fail) under flight loads is considered maximum survivability for the purpose of this study. Thus, loss of a joint is the damage criterion employed in this study.

Static and dynamic analyses of three truss design concepts were performed by the NASTRAN (NASA STRuctural ANalysis)[2] program. One of these truss concepts is a simple open truss design. The other two models incorporate the concept of complete substructures. The semimonocoque tail boom of AH-1 helicopter series is used as the basis for a replacement truss tail boom model. The AH-1 series helicopter presents a logical choice to develop a truss structure tail boom to

[2]Caleb, W. McCormick, Editor, The NASTRAN User's Manual, NASA SP 222(03), March 1976, Washington, D.C.

replace a semimonocoque structure. This helicopter has been in the Army's arsenal for a while and will continue in service for a number of years.

Selection of the design concept that is most likely to defeat the AA threat mentioned previously is dependent upon highest survivability and lowest weight. A selected design will be built, tested experimentally and reported on separately.

II. PROCEDURES

The longerons are the longitudinal elements which constitute the basic configuration to be employed in the truss structure model development. The basic overall dimensions come from the AH-1G helicopter reported in reference 3 (see figure 1). Longeron pattern at the larger (or base) end has been selected to conform to the bolt pattern of the AH-1G model at the tail boom - main fuselage manufacturing break line. The aerodynamic loading conditions were obtained from Bell Helicopter Company[4]. Common design parameters and formulas are listed in Table 1.

2.1 First Design Development

The initial goal was a high degree of redundancy. Thus, in the first iteration the structural member layout was generated by orienting the outside diagonals at 45° angles from the base. The vertical and transverse members were located at diagonal and longeron intersection points, see figure 2. In addition to the longeron, outside diagonal, and transverse members, diagonal members were included within the

[3]J.D. Cronkite, V.L. Berry, J.E. Brunlsen, A. NASTRAN Vibration Model of AH-1G Helicopter Airframe, June 1974, AD A009482.

[4]Private communication between D.F. Haskell of BRL and D. Reisdorfer, Bell Helicopter Company.

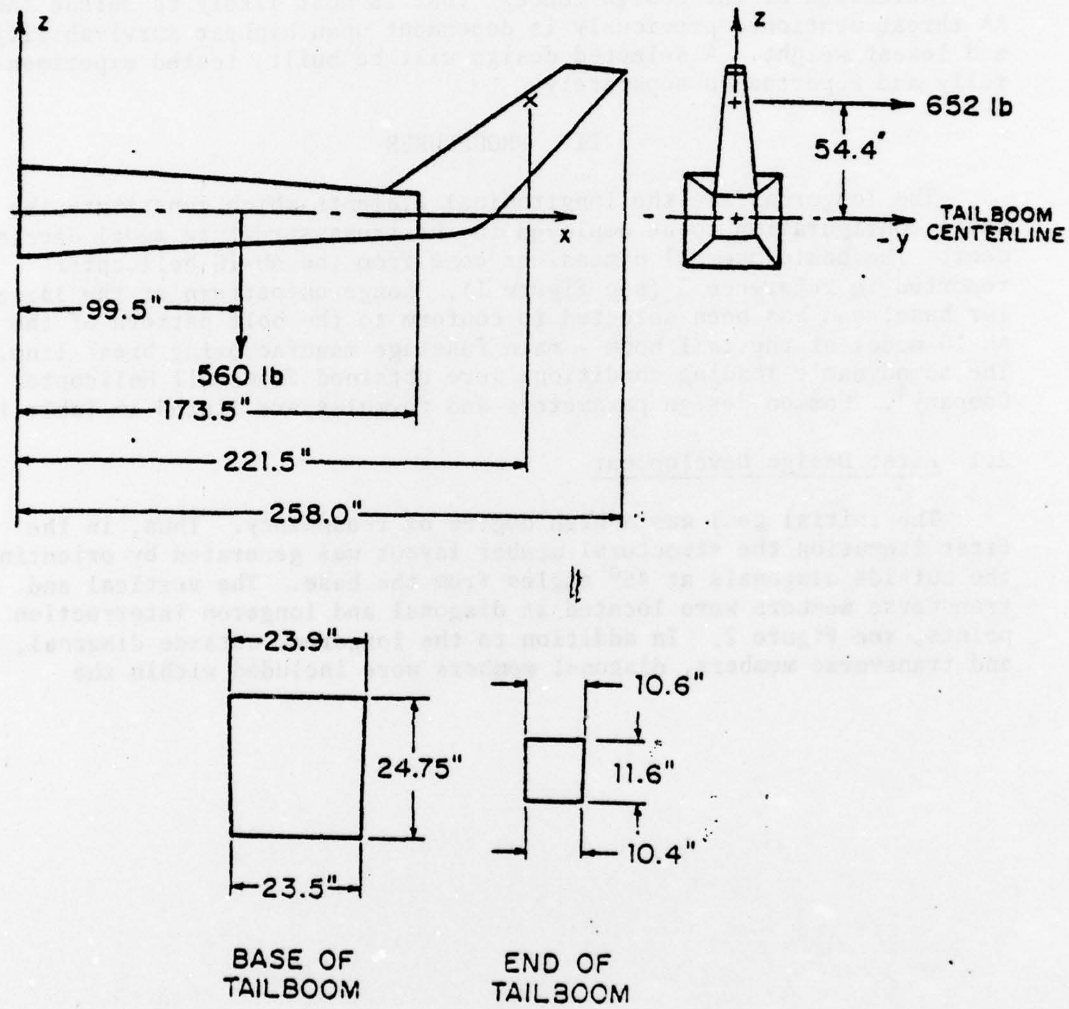

Figure 1. Geometry of Helicopter Tail Boom.

TABLE 1.

Common Design Parameters and Formulas

Material:	Aluminum Alloy	
Modulus of Elasticity:	$E = 7. \times 10^{10}\ n/m^2 (10.5 \times 10^6\ psi)$	(5)
Density ρ:	$\rho = 2.7 \times 10^3\ kg/m^3 (0.1\ lbs/in^3)$	(5)
Margin of Safety: of Individual Member	$M.S. = \dfrac{\text{stress limit}}{\text{applied stress}} - 1.$	(6)

Stress Limits per member

Compressive	$CSL = .8 * \delta_{cr}$
Tensile	$TSL = \delta_{cr}$

Euler Column Buckling (7)

$$\delta_{cr} = \frac{Pcr}{CSA}$$

Cross Sectional Area of Tube: $CSA = \pi(r_o^2 - r_i^2)$

Compressive Critical Load with Hinged Ends (7)

$$Pcr = \frac{\pi^2 EI}{l^2} \quad \text{where } l = \text{length of member}$$

[5] ALCOA STRUCTURAL HANDBOOK. A Design Manual for Aluminum Company of America, Pittsburg, PA, 1958.

[6] NASTRAN Programmer's Manual, NASA SP-221(03), July, 1976, Washington, D.C.

[7] S. Timoshenko, Strength of Materials, Part I. D. VanNostrand Company, Inc., New York, N.Y., 1940, pp 244-254.

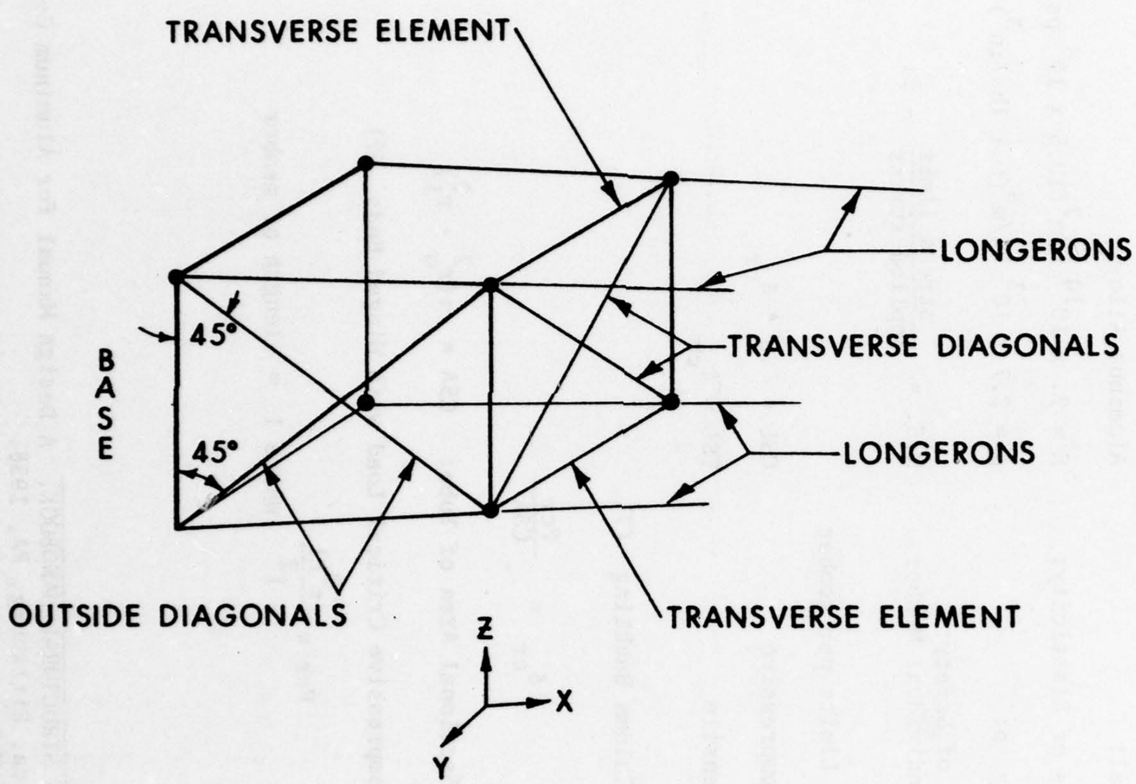

Figure 2. First Iteration Member Layout.

transverse sections defined by the transverse members, see figure 2. This layout was aided by geometry programs developed in-house[8]. The overall configuration consists of 44 joints, 120 degrees of freedom, with 186 members.

Analyses of this first design concept were started with the structural optimization program OPTBAR[9]. The OPTBAR program is an optimization procedure based on an energy criterion and a search procedure based on constraint gradient values. Constraint values of the geometric configuration, same material throughout, minimum element sizes and stress limit are input to OPTBAR and the indeterminate structure is optimized to lowest weight design. For this first simple open truss model the lowest weight was 44.45 kg (98 lbs). Initial damage criteria was loss of a member or members, and analyses of these cases produced higher weights. This was predictable because as the load path changes OPTBAR must strengthen the remaining members to take up the load. Of course, a critical event would be the loss of a joint and analyses simulating the loss of a joint using OPTBAR on the first iteration model indicated a geometrical instability.

Intuitively, one can observe the geometrical instability in a triangular cross section based truss (figure 3) if it would lose a joint. The structural integrity of a quadrilateral cross section based simple open truss that absorbed a loss of a joint has an uncertainty factor. This uncertainty in the simple open quad based truss led to the belief that it may be dependent on each and every joint. Dependence on a joint and the uncertainty of structural stability due to a geometric instability when a joint is lost reduces confidence in structural integrity.

This "simple" open truss structure was deemed unacceptable (simple is defined here as joint dependent). At this time the damage criterion was firmly established to be the loss of a single joint. A concept for independence of a joint was needed to reduce uncertainty of stability and increase confidence of structural integrity after damage. A number of ideas were passed over until the idea of complete substructures was conceived.

The concept that was used to generate complete substructures so as to obtain joint independence introduced the interior diagonals. The connection of all the interior diagonals from vertical station to vertical station generates forty additional elements in this first design. Because of the inclusion of these interior diagonals an increase in weight occurs, however, an increase in survivability is conceptually

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[8]Keith Applin, Gary Kuehl; "Geometry Programs to Aid in Producing COM-GEOM Target Descriptions," BRL Memorandum Report No. 2712 Dec 1976.

[9]V.B. Venkayya, Design of Optimum Structures-Computers and Structures, Vol. 1, pp 285-309, Pergamon Press 1971.

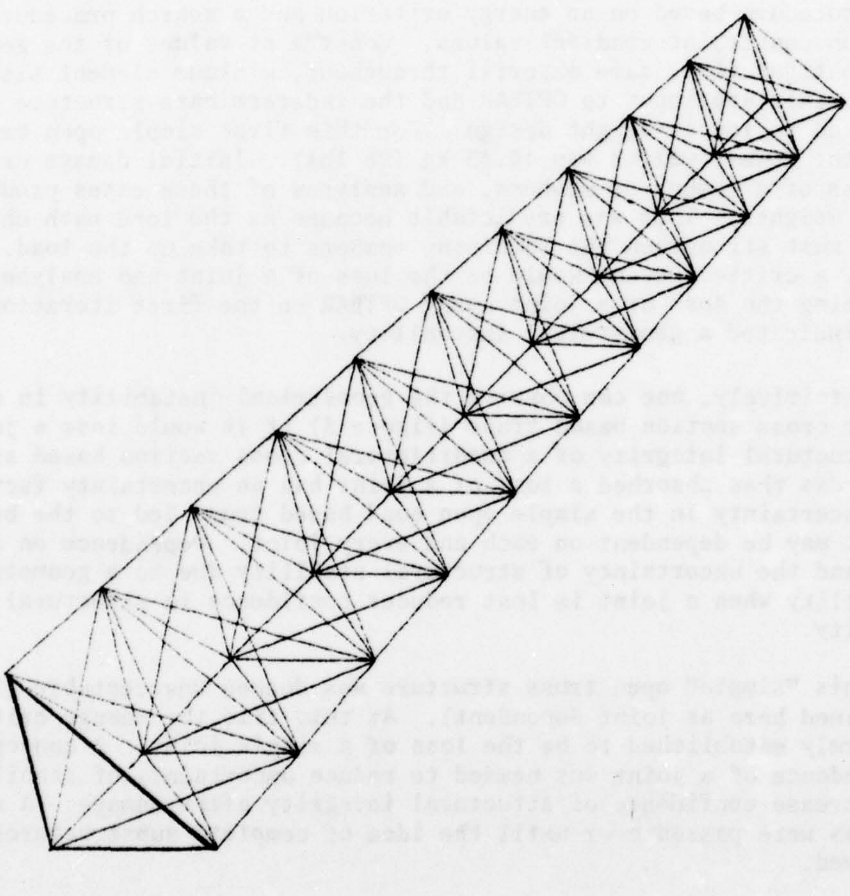

Figure 3. Computer Drawing of a Complete Triangular Substructure of Model 1.

assured because the structure's configuration has increased the ability to retain structural integrity after imposition of the loss of a joint. This method populates a joint with eleven members to be connected and generates a structure that has four complete triangular-based substructures (figure 3) within the entire quadrilateral cross section based structure (figure 4). This structure is highly redundant. The structure of figure 3 is a subset of that shown in figure 4. Figure 5 shows the fully connected composition of the addition of interior diagonals to the structure between the base and vertical station 1. The composition of this structure is truly shown in figure 6 which presents the base, vertical station 1 and vertical station 2. Note that the joints within the extremities are highly populated with eleven members per joint.

This new configuration has 226 members with 44 joints and 120 degrees of freedom. This complete, highly redundant truss when operated on by OPTBAR optimization analysis came to a weight of approximately 52.16 kg (115 lbs). The problem with the structural optimization scheme is that the optimization is for one and only one particular solution (weight optimization). The program results in a wide variety of cross sectional areas to the members so as to optimize the load path. Realistically there cannot be a universe of different size members; however, the weight output can be thought of as representative of an ideal lower bound. Being limited to this one area obviously does not account for a design-to-cost or a design-to-logistics solution.

A full accounting optimization could be defined as: design-to-cost, design-to-weight, design-to-logistics, and many other design-to-areas. For our purposes this study attempts to account for the three areas specifically mentioned. Considering cost and logistics, the ideal design would be to have all the truss members with the same cross sectional end dimensions. It costs less to buy a large quantity of structural elements all the same size than to buy small quantities of various sizes.

The standard tube structural element was chosen for this conceptual design study because of the tube's high inertia over rods of the same cross sectional area. Standard structural tube dimensions[5] provide a wide range of possible designs (see Table 2). Analyses of the first design by changing standard dimensions allow a number of possible choices. Cases increment upward in weight by the different standard structural member dimensions. The structural element choice is 3.81 cm (1 1/2") outside diameter tubes with .159 cm (1/16") thickness. Using these element dimensions the first design weighs 63.73 kg (140.5 lbs) and meets our definition of full accounting.

Since these parameters are now set, the weight optimization program cannot be used for our analysis. Structural analyses from here on are performed by NASTRAN (NASA STRuctural ANalysis)[2]. NASTRAN is a large, comprehensive, general purpose, finite element, displacement method,

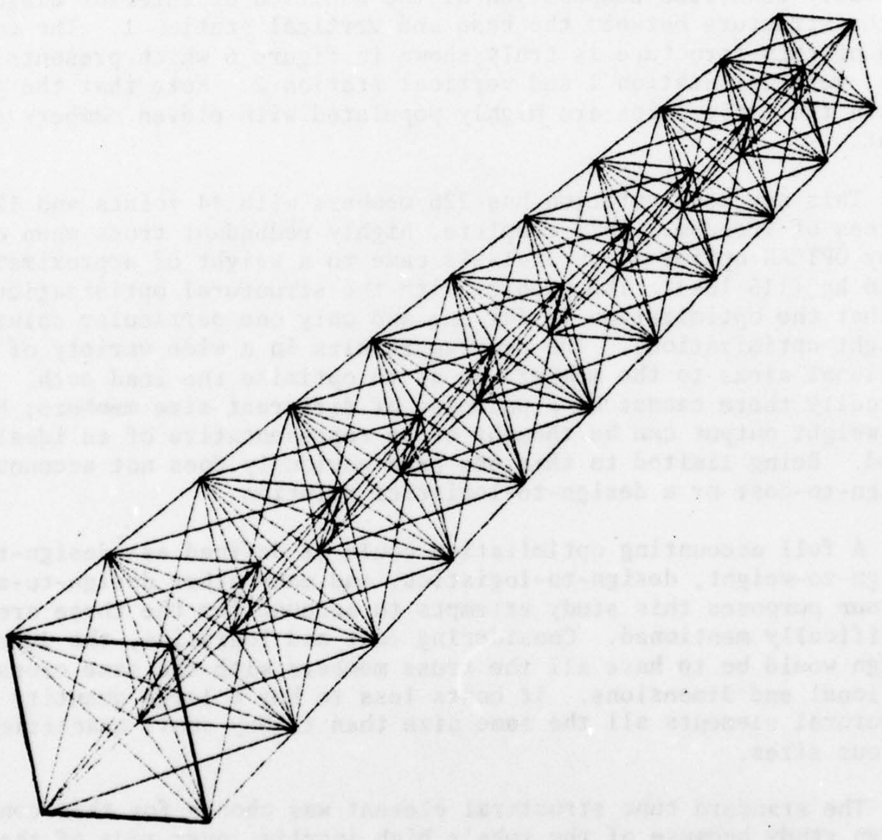

Figure 4. Computer Drawing of the Complete Quad Based Structure Model 1.

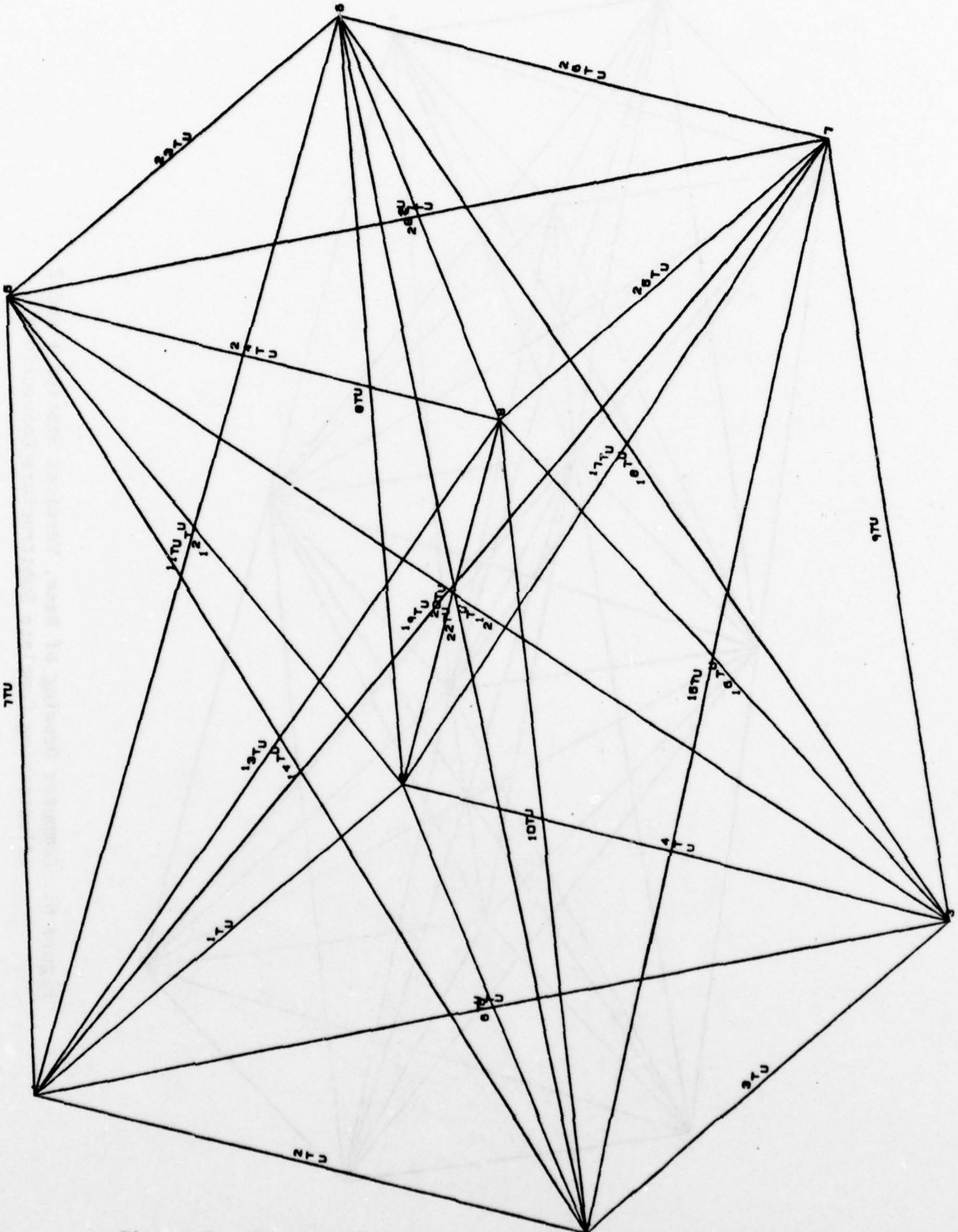

Figure 5. Computer Drawing of the Base and Vertical Station 1 Illustrating the Fully Connected Composition of the Structure.

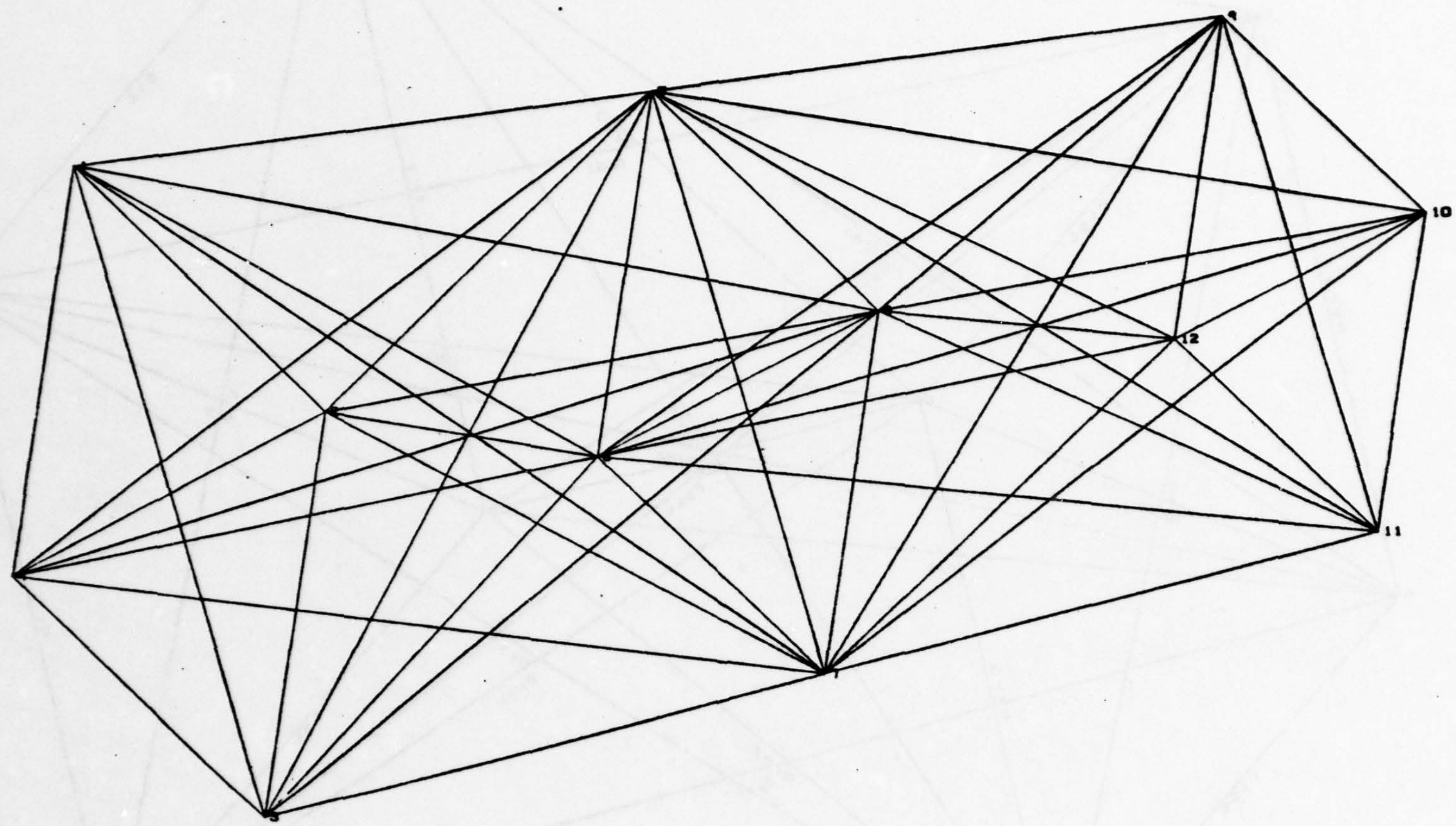

Figure 6. Computer Drawing of Base, Vertical Station 1 and 2 Illustrating Complete Substructure Connections.

TABLE 2

Different Weight Cases of First Design

Design	O.D.	Thickness	Weight
Interior Diagonals	3.81 cm (1 1/2")	.159 cm (1/16")	46.27 kg
Outer Members	3.81 cm (1 1/2")	.0795 cm (1/32")	(102 lbs)
All Members	3.81 cm (1 1/2")	.159 cm (1/16")	63.73 kg (140.5 lbs)
Interior Diagonals	4.45 cm (1 3/4")	.159 cm (1/16")	66.22 kg
Outer Members	3.81 cm (1 1/2")	.159 cm (1/16")	(146 lbs)
Interior Diagonals	4.45 cm (1 3/4")	.159 cm (1/16")	66.68 kg
Outer Members	4.45 cm (1 3/4")	.079 cm (1/32")	(147 lbs)
All Members	4.45 cm (1 3/4")	.159 cm (1/16")	74.66 kg (164.6 lbs)
All Members	5.04 (2")	.159 cm (1/16")	85.73 kg (189 lbs)

computer program. NASA, other government agencies, and aerospace industries have been using it for a number of years now for design and analysis of all forms of airframes.

The NASTRAN rigid format 3, Normal Modes and Frequencies, is a dynamic analysis providing the mode shapes and resonant frequencies of complete models. Analysis of flight loads on the models is performed by NASTRAN rigid format 4, Static Analysis with Differential Stiffness. This method was chosen over rigid format 1, Static Analysis, because design operating stresses are more accurately calculated for analysis of buckling failure of individual members[10]. The NASTRAN mathematical model in the design of the truss structure is straight forward. The joints are grid points and the connections made are with the standard line element CTUBE[2].

2.2 Weight Reduction by Changing Geometry Layout

The initial model truly achieves a high degree of redundancy and populates the structure with many members. This configuration, however, is not a low weight design. To obtain a geometric configuration conducive to a low weight design without doing a geometry optimization analysis, this study utilizes only the joint locations described in reference 11 for the second and third design cases.

2.3 Second Design Case

The second design is a "simple" open truss. The longeron elements are again following the longeron locations of the AH-1 series type helicopter. The configuration consists of 28 joints, 114 members, and 72 degrees of freedom. The same tube dimensions that are in the first design are used here. This configuration (see figure 7) weighs approximately 40.82 kg (90 lbs). This design case is included as a comparison to the third design case.

2.4 The Third Design Case

The third design has the same geometry as the second design except that the interior diagonals are introduced to generate complete substructures. This design has 138 members with 28 joints and 72 degrees of freedom. This highly redundant truss design weighs approximately 52.16 kg (115 lbs) (see figure 8), using the same 3.81 cm (1 1/2") outside diameter tubes with .159 cm (1/16") thickness.

[10] Robert B. Bennett, NASTRAN Differential Stiffness, Analysis of an Aircraft Canopy, NASA TMX 2378 p 85-105, September 1971.

[11] J. S. Arora, E. J. Haug, A. K. Govil, Fail-Safe Design of an Open Truss Helicopter Tail Boom, Technical Report #32, April 1977, College of Engineering, University of Iowa.

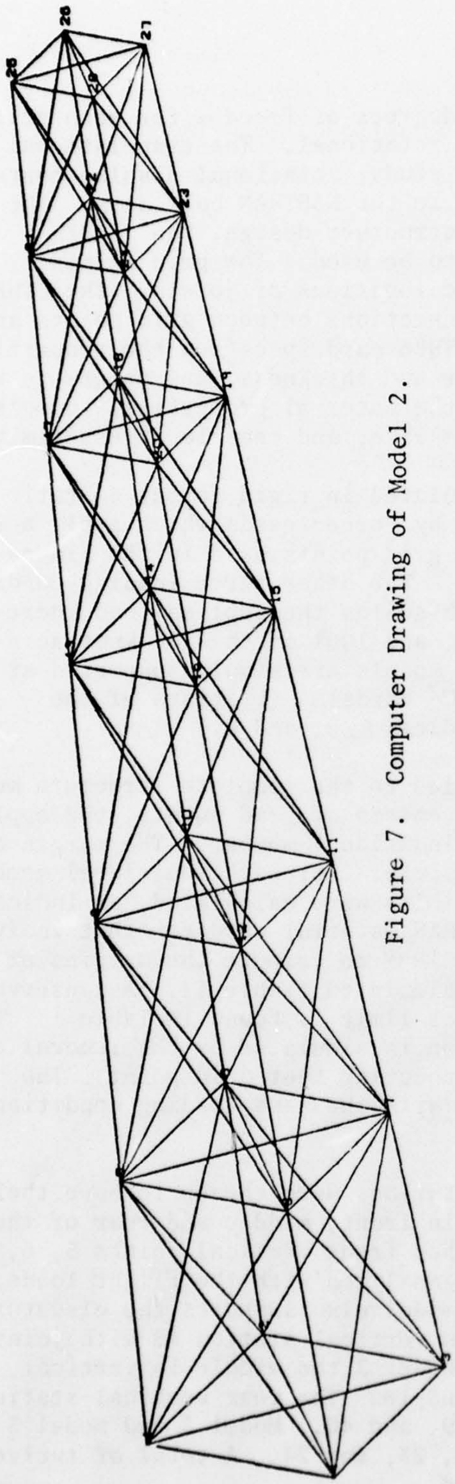

Figure 7. Computer Drawing of Model 2.

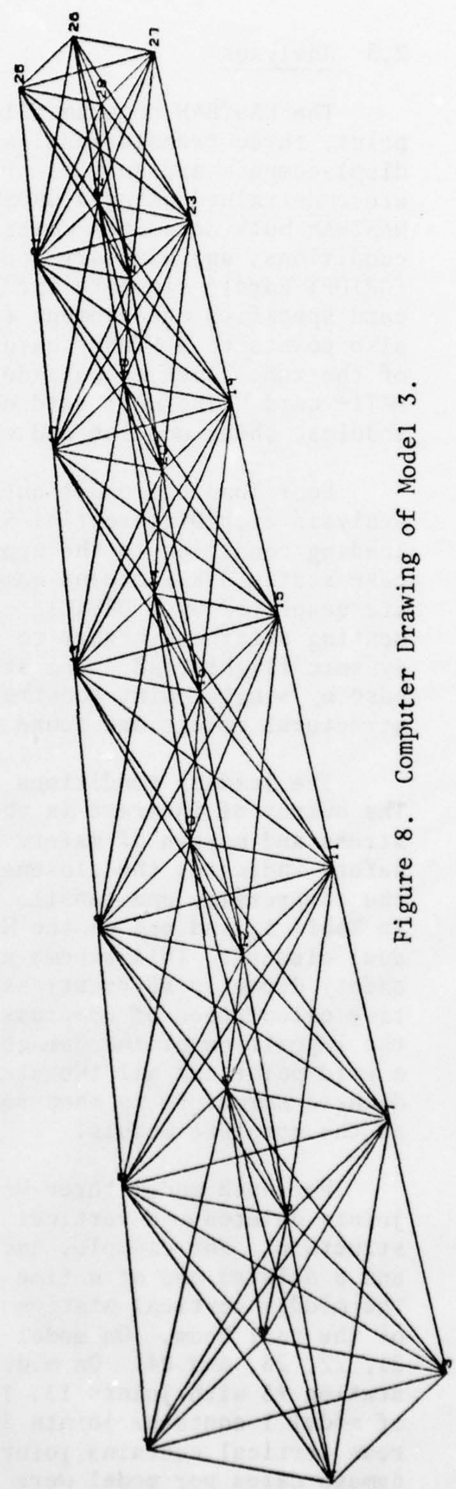

Figure 8. Computer Drawing of Model 3.

2.5 Analyses

The NASTRAN program allows six degrees of freedom for each grid point, three translational and three rotational. The translational displacements are sufficient in this study; rotational displacements are constrained using a GRDSET[2] card in the NASTRAN bulk data. The NASTRAN bulk data deck contains the structure design, the loading conditions, and boundary conditions to be used. The grid points (GRIDPT card)[2] simulate the geometric locations of joints. The CTUBE[2] card specifies the element (tube) connections between grid points and also points to a PTUBE[2] card. The PTUBE card specifies the properties of the tube, such as outside diameter and thickness, and points to the MAT1[2] card. The MAT1 card contains the material properties, Young's modulus, shear modulus and the compressive, and tensile stress limits.

Four loading conditions are simulated in rigid format 4 Static Analysis with Differential Stiffness by Force[2] cards which apply a 30% loading condition to the appropriate grid points used in the linear first case static displacement computation. The other three loading conditions are generated by a DSFACT[2] card which scales the applied load incrementing stiffness higher to 50%, 75%, and 100% of the 130 knot aerodynamic flight load. The structural models are simply supported at the base by single point constraints (SPC[2] cards). (Listings of the structural models are found in Appendices A, B, and C.)

The loading conditions are applied to the complete structure models. The output of interest is the displacements of grid points, the applied stress and margin of safety of each individual member. The margin of safety indicates the closeness of failure. For each individual member the compressive and tensile stress limits were calculated, as indicated in Table 1, and put on the MAT1 NASTRAN material card for that individual element. This scheme allows NASTRAN to compute the margins of safety directly after stresses are calculated (Table 1). A conservative calculation of compressive stress limit is found in Table 1. Then the imposition of the damage criterion is simulated by the removal of a grid point and all the elements connecting that grid point. The damaged structure is then reanalyzed with the same loading conditions as the complete models.

For each model three vertical stations were chosen to have their joints deleted -- a vertical station in front, middle and rear of the structure. For example, each model had front vertical joints 5, 6, 7, and 8 deleted one at a time and then analyzed with the flight loads. The middle vertical station of each model also supports the elevator of the tail boom. On model 1 this is vertical station #5 with joints 21, 22, 23, and 24. On model 2 and model 3 the middle is vertical station #3 with joints 13, 14, 15, and 16. The rear vertical station of model 1 contains joints 37, 38, 39, and 40. Model 2 and model 3 rear vertical contains joints 21, 22, 23, and 24. A total of twelve damage cases per model were simulated.

Extraction of a structure's natural frequencies can be performed by rigid format 3 of NASTRAN Normal Modes and Frequencies. These natural frequencies of structures are important in the analyses of aircraft structures. The natural frequencies are found only for the complete structures in this study.

2.6 Procedural Assumption

The existing semimonocoque tail boom at the base is canted at a small angle upward. Assuming a vertical base in our models is believed to be acceptable. Realistically, portions of members that enter a joint may remain affixed to the truss structure after loss of a joint. The effects of these members (or portions thereof) remaining are considered minor, and therefore are neglected in this study.

III. RESULTS

The appendices A, B, and C are listings of each complete model plus the results of displacements of each joint, stresses and margins of safety for each element for the applied loads. Resultant geometry framework is given in Appendices D, E, and F. Appendix D specifies the element connections between joints. The connection scheme is a replication and is valid for all the truss models. The only exceptions are: models 2 and 3 end at element number 138 and model 2 does not contain interior diagonals. Appendix E lists the joint locations of model 1 and Appendix F lists the joint locations of models 2 and 3.

3.1 Displacements

Maximum deflections at the end of the boom are limited because the maximum angle of the driveshaft couplings is 1°. Figure 9 shows where the couplings are located in reference to the end of the boom and provides the maximum deflection constraint to be 8.13 cm (3.2 in). Table 3 shows the maximum displacements of the truss models with and without damage imposed. These displacements lie comfortably within this maximum deflection constraint.

Table 4 lists the ratio of damage conditions displacements to the undamaged condition displacements of the complete longeron diagonally opposite a deleted node for damage to model 1. Each loading condition is presented. Translations of the X direction displacement are insignificant and not presented.

Table 5 lists the same results for model 2 and the results for model 3 are listed in Table 6.

3.2 Margins of Safety

The margin of safety of an individual element indicates its closeness to failure. Buckling failure determined by margin of safety

$\ell_1 = 159.72\text{cm}$ (62.88 in.)
$\ell_2 = 155.04\text{cm}$ (60.04 in.)

$d_I = \ell_I \tan I^o \quad I=1,2$

$d_1 = \ell_1 \tan 1^o = 2.79\text{cm}$ (1.10 in.)

$d_2 = \ell_2 \tan 2^o = 5.33\text{cm}$ (2.10 in.)

$d_T = d_1 + d_2$

$d_T = 8.12\text{cm}$ (3.2 in.)

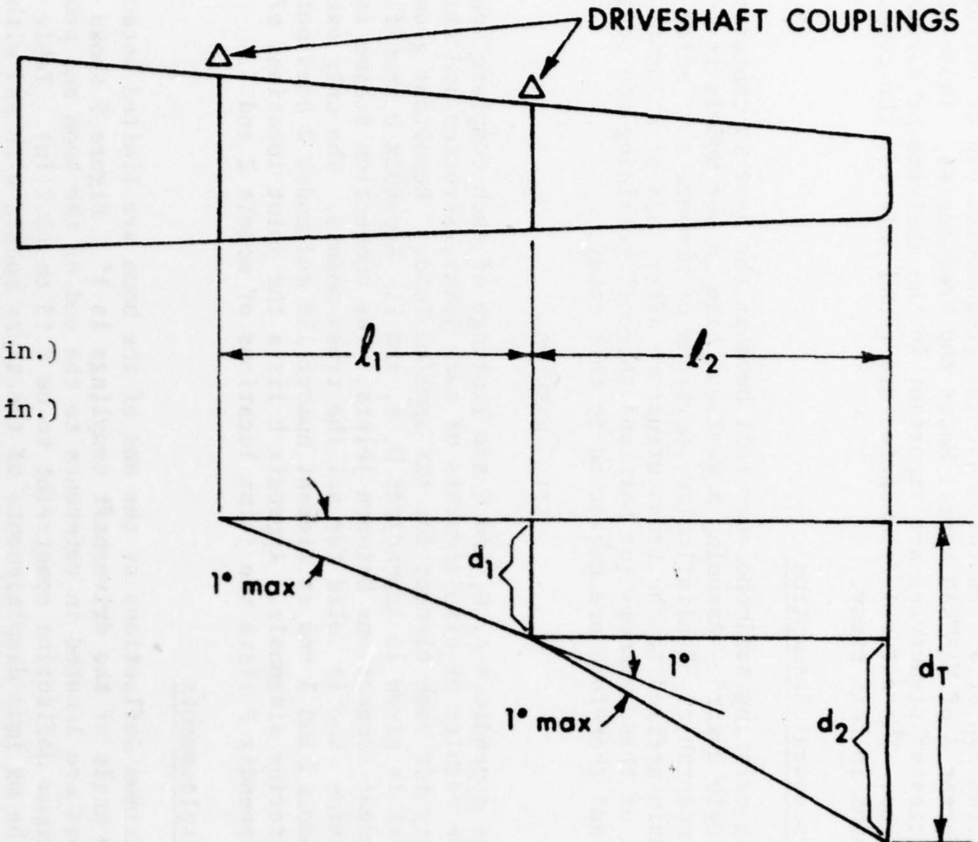

Figure 9. Maximum Deflection Constraint Due to Drive Shaft Couplings.

TABLE 3
Maximum Displacement at End of Boom Due to 100% Flight Load
With Joints Deleted

MODEL 1			MODEL 2			MODEL 3	
Damage	y	z	Damage	y	z	y	z
None	1.17cm	.797cm	None	1.09cm	.797cm	1.10cm	.784cm
-5	1.97cm	1.55cm	-5	1.91cm	1.55cm	1.89cm	1.53cm
-6	1.08cm	.9.50cm	-6	1.10cm	.955cm	1.10cm	.935cm
-7	1.91cm	1.55cm	-7	1.83cm	1.60cm	1.84cm	1.53cm
-8	1.11cm	.965cm	-8	1.17cm	1.01cm	1.13cm	.950cm
-21	1.45cm	1.02cm	-13	1.55cm	1.04cm	1.50cm	1.04cm
-22	1.37cm	.635cm	-14	1.32cm	.630cm	1.33cm	.635cm
-23	1.35cm	1.04cm	-15	1.34cm	1.22cm	1.37cm	1.14cm
-24	1.42cm	.650cm	-16	1.53cm	.81cm	1.46cm	.726cm
-37	1.30cm	.866cm	-21	1.43cm	.889cm	1.36cm	.899cm
-38	1.21cm	.772cm	-22	1.15cm	.726cm	1.19cm	.741cm
-39	1.24cm	.901cm	-23	1.17cm	1.10cm	1.21cm	1.01cm
-40	1.27cm	.795cm	-24	1.39cm	.924cm	1.33cm	.843cm

TABLE 4a. Ratio of Damage Displacements to Undamage Displacements on Longeron Opposite Damage Criterion

MODEL 1 $r_i = \frac{DD}{UD}$, $i = y,z.$

Damage - Joint 5

Lower Right Longeron (view from rear)	Load Joint	30% Y	30% Z	50% Y	50% Z	75% Y	75% Z	100% Y	100% Z
	7	-.522	1.42	-.541	1.40	-.244	1.41	-.430	1.40
	11	-37.9	1.92	-40.1	1.91	-41.5	1.92	-43.1	1.93
	15	8.02	2.03	8.19	3.01	8.16	2.05	8.17	2.05
	19	4.73	2.00	4.81	2.09	4.74	2.03	4.77	2.04
	23	3.51	1.98	3.59	2.01	3.48	1.98	3.52	1.99
	27	2.90	1.97	2.90	1.98	2.92	1.96	2.93	1.97
	31	2.57	1.96	2.55	1.95	2.54	1.95	2.56	1.96
	35	2.24	1.95	2.23	1.94	2.21	1.94	2.23	1.94
	39	2.01	1.94	2.01	1.93	2.02	1.93	2.10	1.93
	43	1.97	1.93	1.98	1.92	1.96	1.91	1.97	1.92

Damage - Joint 21

	Load Joint	30% Y	30% Z	50% Y	50% Z	75% Y	75% Z	100% Y	100% Z
	7	1.00	1.00	.99	1.00	.992	1.00	.989	1.00
	11	1.02	1.00	.94	1.00	.898	1.00	.857	1.00
	15	1.00	1.00	1.00	1.00	1.0	1.00	1.00	1.00
	19	.99	1.00	.990	1.00	.990	1.00	1.00	1.00
	23	1.05	1.02	1.06	1.02	1.07	1.02	1.08	1.02
	27	1.20	1.10	1.21	1.10	1.21	1.10	1.22	1.10
	31	1.27	1.17	1.28	1.18	1.28	1.18	1.29	1.19
	35	1.29	1.21	1.31	1.22	1.31	1.22	1.31	1.23
	39	1.30	1.25	1.31	1.25	1.31	1.26	1.32	1.27
	43	1.29	1.27	1.29	1.28	1.30	1.28	1.31	1.29

Damage - Joint 37

	Load Joint	30% Y	30% Z	50% Y	50% Z	75% Y	75% Z	100% Y	100% Z
	7	1.00	1.00	.99	1.00	1.0	1.00	.985	1.00
	11	1.00	1.00	.87	1.00	.801	1.00	.722	1.00
	15	1.00	1.00	1.00	1.00	1.03	1.00	1.05	1.00
	19	1.00	1.00	1.01	1.00	1.02	1.00	1.03	1.00
	23	1.00	1.00	1.01	1.00	1.02	1.00	1.02	1.00
	27	1.00	1.00	1.01	1.00	1.02	1.00	1.02	1.00
	31	1.00	1.00	1.01	1.00	1.02	1.00	1.02	1.00
	35	1.00	1.00	1.01	1.00	1.02	1.00	1.02	1.00
	39	1.01	1.02	1.02	1.02	1.03	1.02	1.04	1.02
	43	1.07	1.07	1.08	1.07	1.09	1.07	1.09	1.08

TABLE 4b. Ratio of Damaged Displacements to Undamaged Displacements on Longeron Opposite Damage Criterion

MODEL 1 $r_i = \frac{DD}{UD}$, i = y,z.

Damage - Joint 6

Upper Right Longeron (viewed from rear)	Load Joint	30% Y	30% Z	50% Y	50% Z	75% Y	75% Z	100% Y	100% Z
	8	.899	1.11	.896	1.11	.892	1.12	.889	1.12
	12	.848	1.21	.843	1.21	.837	1.22	.831	1.22
	16	.857	1.22	.852	1.22	.848	1.23	.841	1.23
	20	.867	1.20	.860	1.21	.857	1.22	.854	1.22
	24	.880	1.19	.879	1.20	.879	1.20	.868	1.20
	28	.893	1.19	.889	1.20	.885	1.20	.883	1.20
	32	.903	1.19	.901	1.19	.895	1.19	.894	1.19
	36	.913	1.18	.908	1.18	.906	1.19	.905	1.19
	40	.915	1.18	.915	1.18	.915	1.19	.913	1.18
	44	.927	1.18	.925	1.18	.922	1.19	.919	1.19
Damage - Joint 22									
	8	.999	.999	1.0	1.0	1.0	1.0	1.0	1.0
	12	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	16	.998	1.0	.998	1.0	.999	1.0	1.0	1.0
	20	1.0	1.0	1.0	1.0	.999	1.0	.998	1.0
	24	1.02	.986	1.02	.989	1.02	.991	1.02	.992
	28	1.10	.901	1.10	.916	1.09	.929	1.09	.932
	32	1.15	.858	1.15	.864	1.14	.875	1.13	.880
	36	1.17	.815	1.17	.826	1.16	.837	1.15	.843
	40	1.18	.785	1.18	.788	1.17	.810	1.16	.818
	44	1.18	.758	1.18	.773	1.17	.788	1.17	.797
Damage - Joint 38									
	8	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	12	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	16	1.0	1.0	1.0	1.0	.996	1.0	1.0	1.0
	20	1.0	1.0	1.0	1.0	.995	1.0	.995	1.0
	24	1.0	1.0	1.0	1.0	.995	1.0	.994	1.0
	28	1.0	1.0	1.0	1.0	.995	1.0	.993	1.0
	32	1.0	1.0	1.0	1.0	.994	1.01	.992	1.0
	36	1.0	1.0	1.0	1.01	.995	1.01	.994	1.01
	40	1.01	.991	1.01	.997	1.0	1.0	1.0	1.0
	44	1.04	.947	1.04	.954	1.04	.960	1.03	.964

TABLE 4c. Ratio of Damaged Displacements to Undamaged Displacements on Longeron Opposite Damage Criterion

Model 1 $r_i = \frac{DD}{UD}$, i = y,z

Damage - Joint 7

Upper Left Longeron (viewed from rear)	Load Joint	30% Y	30% Z	50% Y	50% Z	75% Y	75% Z	100% Y	100% Z
	5	1.5	-5.63	1.51	-6.56	1.53	-7.13	1.54	-7.77
	9	2.13	5.05	2.14	4.99	2.16	4.94	2.17	4.89
	13	2.20	3.69	2.22	3.68	2.24	3.66	2.26	3.64
	17	2.11	3.18	2.13	3.16	2.15	3.15	2.16	3.14
	21	2.0	2.90	2.01	2.89	2.03	2.88	2.04	2.87
	25	1.89	2.79	1.9	2.78	1.92	2.77	1.93	2.75
	29	1.80	2.72	1.82	2.70	1.83	2.68	1.84	2.67
	33	1.72	2.67	1.73	2.65	1.75	2.64	1.76	2.62
	37	1.66	2.69	1.67	2.66	1.68	2.62	1.69	2.58
	41	1.60	2.60	1.61	2.58	1.62	2.55	1.63	2.53

Damage - Joint 23

	5	1.0	1.0	1.0	1.0	1.0	.992	1.0	.983
	9	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	13	1.0	1.0	1.0	1.0	1.0	1.01	1.0	1.01
	17	1.0	.987	1.0	.990	1.01	.973	1.01	.995
	21	1.03	1.03	1.03	1.03	1.04	1.04	1.04	1.04
	25	1.10	1.17	1.10	1.17	1.11	1.18	1.12	1.18
	29	1.15	1.28	1.15	1.29	1.16	1.30	1.17	1.30
	33	1.17	1.36	1.17	1.36	1.18	1.36	1.19	1.36
	37	1.18	1.41	1.18	1.41	1.19	1.41	1.20	1.41
	41	1.18	1.44	1.19	1.44	1.19	1.44	1.20	1.44

Damage - Joint 39

	5	1.0	1.0	1.0	1.0	1.0	.990	1.0	.928
	9	1.0	1.0	1.0	1.0	1.0	1.01	1.0	1.02
	13	1.0	1.0	1.0	1.01	1.0	1.01	1.01	1.01
	17	1.0	1.0	1.0	1.01	1.0	1.01	1.01	1.01
	21	1.0	1.0	1.0	1.0	1.01	1.0	1.01	1.01
	25	1.0	1.0	1.01	1.0	1.01	1.01	1.01	1.01
	29	1.0	1.0	1.01	1.01	1.01	1.01	1.01	1.01
	33	1.0	1.0	1.01	1.01	1.01	1.01	1.01	1.01
	37	1.01	1.02	1.02	1.02	1.02	1.03	1.02	1.03
	41	1.04	1.10	1.04	1.10	1.05	1.11	1.05	1.11

TABLE 4d. Ratio of Damaged Displacements to Undamaged Displacements on Longeron Opposite Damage Criterion

Model 1 $r_i = \frac{DD}{UD}$, i = y,z.

Damage - Joint 8

Lower Left Longeron (viewed from rear)	Load Joint	30% Y	30% Z	50% Y	50% Z	75% Y	75% Z	100% Y	100% Z
	6	1.29	.670	1.30	.651	1.31	.627	1.31	.593
	10	3.06	1.0	3.14	1.33	3.24	1.72	3.32	1.98
	14	.013	1.54	-.040	1.55	-.064	1.56	-.087	1.56
	18	.567	1.42	.555	1.43	.538	1.44	.519	1.44
	22	.722	1.36	.710	1.36	.701	1.37	.689	1.38
	26	.795	1.34	.787	1.34	.779	1.35	.771	1.35
	30	.838	1.32	.330	1.32	.324	1.33	.818	1.33
	34	.865	1.31	.859	1.31	.853	1.32	.848	1.32
	38	.887	1.31	.882	1.31	.877	1.31	.872	1.31
	42	.901	1.30	.90	1.30	.889	1.30	.888	1.30

Damage - Joint 24

Load Joint	30% Y	30% Z	50% Y	50% Z	75% Y	75% Z	100% Y	100% Z
6	1.0	.996	1.0	.991	1.0	.985	1.0	.981
10	.998	1.0	1.04	1.01	1.07	1.01	1.09	1.01
14	1.0	1.0	.995	1.0	.989	1.01	.985	1.01
18	.981	.996	.977	.998	.973.	1.0	.969	1.0
22	1.03	.952	1.03	.956	1.02	.960	1.02	.965
26	1.19	.810	1.18	.822	1.17	.834	1.17	.844
30	1.27	.690	1.26	.707	1.25	.725	1.24	.743
34	1.29	.617	1.28	.639	1.27	.660	1.27	.683
38	1.29	.563	1.29	.594	1.28	.623	1.27	.641
42	1.29	.532	1.28	.560	1.27	.691	1.26	.618

Damage - Joint 40

Load Joint	30% Y	30% Z	50% Y	50% Z	75% Y	75% Z	100% Y	100% Z
6	1.0	1.0	1.0	.994	1.0	.990	1.0	.986
10	1.0	1.0	1.02	1.01	1.06	1.01	1.08	1.01
14	1.0	1.0	.983	1.01	.967	1.01	.950	1.01
18	1.0	1.0	.989	1.0	.982	1.01	.971	1.01
22	1.0	1.0	.993	1.0	.985	1.01	.977	1.01
26	1.0	1.0	.994	1.0	.987	1.01	.979	1.01
30	1.0	.991	.996	.997	.988	1.0	.981	1.01
34	.996	.999	.990	1.0	.984	1.0	.978	1.01
38	1.01	.970	1.0	.976	1.0	.981	.996	.987
42	1.07	.868	1.06	.879	1.05	.891	1.05	.902

TABLE 5a. Ratio of Damaged Displacements to Undamaged Displacements on Longeron Opposite Damage Criterion

Model 2 $r_k = \frac{DD}{UD}$, i - y,z.

Damage - Joint 5

Lower Right Longeron (viewed from rear)	Load Joint	30% Y	30% Z	50% Y	50% Z	75% Y	75% Z	100% Y	100% Z
	7	-.144	1.15	-.150	1.16	-.153	1.17	-.158	1.17
	11	-9.47	1.69	-9.83	1.70	-10.02	1.71	-10.21	1.71
	15	10.80	1.82	10.82	1.83	10.77	1.84	10.76	1.84
	19	4.47	1.89	4.53	1.90	4.55	1.90	4.59	1.90
	23	3.11	1.92	3.15	1.91	3.18	1.92	3.20	1.92
	27	2.52	1.95	2.56	1.94	2.57	1.94	2.59	1.94

Damage - Joint 13

Load Joint	30% Y	30% Z	50% Y	50% Z	75% Y	75% Z	100% Y	100% Z
7	1.0	1.0	.998	1.0	.997	1.0	.996	1.0
11	1.14	1.0	1.11	1.0	1.10	1.0	1.09	1.0
15	1.82	.988	1.84	.995	1.87	1.0	1.88	1.0
19	1.94	1.10	1.97	1.12	2.00	1.12	2.02	1.13
23	1.76	1.21	1.79	1.22	1.80	1.23	1.82	1.24
27	1.63	1.27	1.66	1.29	1.68	1.31	1.69	1.31

Damage - Joint 21

Load Joint	30% Y	30% Z	50% Y	50% Z	75% Y	75% Z	100% Y	100% Z
7	1.0	1.0	.994	1.0	.990	1.0	.985	1.0
11	.998	1.0	.960	1.0	.940	1.0	.918	1.01
15	.998	1.0	1.04	1.0	1.06	1.0	1.08	1.01
19	.977	1.0	.996	1.0	1.0	1.01	1.01	1.01
23	1.09	.988	1.11	1.0	1.11	1.0	1.12	1.01
27	1.30	1.07	1.32	1.09	1.33	1.10	1.34	1.11

TABLE 5b. Ratio of Damaged Displacements to Undamaged Displacements on Longeron Opposite Damage Criterion

Model 2 $r_i = \frac{DD}{UD}$, i = y,z.

Damage - Joint 6

Upper Right Longeron (view from rear)	Load Joint	30% Y	30% Z	50% Y	50% Z	75% Y	75% Z	100% Y	100% Z
	8	.860	.973	.855	.977	.852	.981	.849	.986
	12	.919	1.07	.906	1.08	.899	1.09	.893	1.10
	16	1.0	1.13	.989	1.14	,980	1.15	.978	1.16
	20	1.02	1.15	1.01	1.16	1.0	1.17	1.0	1.18
	24	1.02	1.16	1.01	1.17	1.01	1.18	1.0	1.19
	28	1.02	1.17	1.02	1.18	1.01	1.19	1.01	1.19

Damage - Joint 14

Load Joint	30% Y	30% Z	50% Y	50% Z	75% Y	75% Z	100% Y	100% Z
8	.996	1.0	.996	1.0	.995	1.0	.995	1.0
12	.997	1.01	.997	1.01	.996	1.01	.996	1.01
16	.984	.950	.982	.959	.981	.964	.980	.967
20	1.12	.814	1.11	.834	1.11	.842	1.10	.853
24	1.20	.760	1.19	.788	1.18	.799	1.18	.814
28	1.23	.724	1.22	.757	1.21	.769	1.21	.788

Damage - Joint 22

Load Joint	30% Y	30% Z	50% Y	50% Z	75% Y	75% Z	100% Y	100% Z
8	1.0	1.0	1.0	1.0	.997	1.0	.997	1.0
12	1.0	1.0	.998	1.0	.997	1.01	.997	1.01
16	1.0	1.0	.997	1.0	.996	1.01	.996	1.01
20	1.0	1.0	1.0	1.01	.997	1.02	.997	1.02
24	.996	.963	.994	.978	.993	.985	.992	.992
28	1.06	.866	1.05	.890	1.05	.901	1.05	.912

TABLE 5c. Ratio of Damaged Displacements to Undamaged Displacements on Longeron Opposite Damage Criterion

Model 2 $r_i = \frac{DD}{UD}$, i = y,z.

Damage - Joint 7

Upper Left Longeron (view from rear)	Load Joint	30% Y	30% Z	50% Y	50% Z	75% Y	75% Z	100% Y	100% Z
	5	1.13	-5.89	1.12	-7.54	1.15	-8.66	1.15	-10.0
	9	1.77	6.73	1.80	6.32	1.81	6.16	1.83	5.99
	13	1.86	4.75	1.89	4.54	1.91	4.46	1.93	4.38
	17	1.80	4.50	1.82	4.29	1.84	4.20	1.85	4.10
	21	1.71	4.38	1.74	4.11	1.75	4.01	1.76	3.91
	25	1.63	4.24	1.65	4.00	1.66	3.92	1.67	3.78

Damage - Joint 15

	Load Joint	30% Y	30% Z	50% Y	50% Z	75% Y	75% Z	100% Y	100% Z
	5	.994	1.03	.996	.987	.997	.952	.998	.918
	9	1.0	.925	1.0	.959	1.0	.968	1.0	.987
	13	.986	1.34	.988	1.34	.990	1.34	.992	1.34
	17	1.10	1.93	1.11	1.90	1.12	1.88	1.12	1.86
	21	1.18	2.11	1.19	2.05	1.20	2.03	1.20	2.00
	25	1.21	2.23	1.21	2.15	1.22	2.12	1.22	2.09

Damage - Joint 23

	Load Joint	30% Y	30% Z	50% Y	50% Z	75% Y	75% Z	100% Y	100% Z
	5	1.0	1.0	1.0	.960	1.0	.888	1.0	.800
	9	1.0	1.0	1.0	1.03	1.0	1.05	1.0	1.06
	13	1.0	1.0	1.0	1.04	1.0	1.06	1.0	1.06
	17	1.0	.982	1.0	1.01	1.0	1.03	1.0	1.05
	21	.996	1.13	1.0	1.15	1.0	1.17	1.0	1.19
	25	1.06	1.49	1.06	1.49	1.07	1.49	1.07	1.49

TABLE 5d. Ratio of Damaged Displacements to Undamaged Displacements on Longeron Opposite Damage Criterion

Model 2 $r_i = \frac{DD}{UD}$, i = y,z.

Damage - Joint 8

Lower Left Longeron (view from rear)	Load Joint	30% Y	30% Z	50% Y	50% Z	75% Y	75% Z	100% Y	100% Z
	6	.637	-.760	.656	-.978	.666	-1.09	.675	-1.23
	10	-.136	2.86	.011	2.79	.082	2.77	.153	2.74
	14	1.66	1.81	1.48	1.82	1.40	1.83	1.31	1.84
	18	1.17	1.66	1.11	1.67	1.09	1.69	1.06	1.69
	22	1.09	1.59	1.06	1.60	1.04	1.60	1.02	1.61
	26	1.05	1.54	1.03	1.54	1.02	1.55	1.0	1.55

Damage - Joint 16

Load Joint	30% Y	30% Z	50% Y	50% Z	75% Y	75% Z	100% Y	100% Z
6	.996	.978	.997	.954	.998	.941	1.0	.927
10	1.16	.995	1.18	1.02	1.18	1.03	1.19	1.04
14	1.81	1.18	1.75	1.20	1.72	1.21	1.70	1.21
18	2.00	.735	1.95	.833	1.93	.875	1.91	.911
22	1.82	.381	1.78	.541	1.76	.602	1.74	.666
26	1.68	.200	1.65	.397	1.63	.474	1.62	.549

Damage - Joint 24

Load Joint	30% Y	30% Z	50% Y	50% Z	75% Y	75% Z	100% Y	100% Z
6	1.0	1.0	1.0	.950	1.0	.960	1.01	.945
10	1.0	.998	1.02	1.02	1.04	1.04	1.05	1.06
14	.998	1.0	.960	1.02	.943	1.04	.928	1.05
18	.977	1.0	.960	1.03	.953	1.04	.946	1.05
22	1.09	1.04	1.07	1.08	1.07	1.09	1.06	1.11
26	1.30	.713	1.28	.815	1.27	.857	1.26	.895

TABLE 6a. Ratio of Damage Displacements to Undamaged Displacements on Longeron Opposite Damage Criteria

MODEL 3 $r_i = \frac{DD}{UD}$, i = y,z.

Damage - Joint 5

Lower Right Longeron (view from rear)	Load Joint	30% Y	30% Z	50% Y	50% Z	75% Y	75% Z	100% Y	100% Z
	7	.129	1.29	.118	1.30	.112	1.30	.106	1.30
	11	-9.28	1.80	-9.67	1.81	-9.90	1.82	-10.13	1.82
	15	9.53	1.89	9.55	1.89	9.57	1.90	9.58	1.90
	19	4.22	1.92	4.27	1.92	4.30	1.93	4.33	1.93
	23	3.00	1.94	3.03	1.94	3.05	1.94	3.07	1.94
	27	2.45	1.96	2.48	1.95	2.50	1.95	2.51	1.95

Damage - Joint 13

	Load Joint	30% Y	30% Z	50% Y	50% Z	75% Y	75% Z	100% Y	100% Z
	7	.996	.998	.991	1.0	.988	1.0	.985	1.0
	11	1.14	1.0	1.12	1.02	1.10	1.01	1.09	1.0
	15	1.34	1.04	1.38	1.04	1.40	1.04	1.41	1.04
	19	1.70	1.16	1.73	1.17	1.75	1.18	1.76	1.18
	23	1.64	1.25	1.67	1.26	1.68	1.27	1.70	1.27
	27	1.56	1.30	1.59	1.31	1.60	1.32	1.61	1.32

Damage - Joint 21

	Load Joint	30% Y	30% Z	50% Y	50% Z	75% Y	75% Z	100% Y	100% Z
	7	1.0	1.0	.993	1.0	.990	1.0	.987	1.0
	11	1.0	1.0	.962	1.0	.941	1.0	.920	1.0
	15	1.0	1.0	1.03	1.0	1.05	1.01	1.07	1.01
	19	.983	1.0	1.0	1.01	1.01	1.01	1.01	1.01
	23	1.03	1.02	1.05	1.02	1.06	1.03	1.06	1.03
	27	1.22	1.11	1.23	1.12	1.24	1.13	1.25	1.14

TABLE 6b. Ratio of Damaged Displacements to Undamaged Displacements on Longeron Opposite Damage Criteria

MODEL 3 $r_i = \frac{DD}{UD}$, i = y,z.

Damage - Joint 6

Upper Right Longeron (view from rear)	Load Joint	30% Y	30% Z	50% Y	50% Z	75% Y	75% Z	100% Y	100% Z
	8	.945	1.06	.937	1.06	.934	1.07	.930	1.07
	12	1.0	1.16	.990	1.17	.983	1.18	.976	1.18
	16	1.02	1.16	1.01	1.17	1.0	1.18	1.0	1.19
	20	1.02	1.16	1.01	1.17	1.01	1.18	1.0	1.19
	24	1.02	1.16	1.01	1.17	1.01	1.18	1.0	1.19
	28	1.02	1.16	1.01	1.17	1.0	1.18	1.0	1.19

Damage - Joint 14

	Load Joint	30% Y	30% Z	50% Y	50% Z	75% Y	75% Z	100% Y	100% Z
	8	.997	.933	.997	1.0	.997	1.0	.997	1.0
	12	1.0	1.0	1.0	1.01	1.0	1.01	1.0	1.01
	16	1.02	.980	1.02	.987	1.02	.990	1.02	.994
	20	1.16	.869	1.15	.887	1.15	.895	1.14	.903
	24	1.22	.797	1.21	.822	1.21	.834	1.20	.846
	28	1.23	.749	1.22	.780	1.22	.795	1.21	.810

Damage - Joint 22

	Load Joint	30% Y	30% Z	50% Y	50% Z	75% Y	75% Z	100% Y	100% Z
	8	1.0	1.0	.998	1.0	.997	1.0	.997	1.0
	12	1.0	1.0	.998	1.0	.997	1.0	.997	1.0
	16	1.0	1.0	.997	1.0	.996	1.01	.996	1.01
	20	1.0	1.0	1.0	1.01	1.0	1.01	1.0	1.02
	24	1.01	.985	1.01	.996	1.01	1.0	1.01	1.0
	28	1.09	.905	1.08	.925	1.08	.934	1.07	.943

TABLE 6c. Ratio of Damaged Displacements to Undamaged Displacements on Longeron Opposite Damage Criteria

MODEL 3 $r_i = \frac{DD}{UD}$, i = y,z.

Damage - Joint 7

Upper Left Longeron (view from rear)	Load Joint	30% Y	30% Z	50% Y	50% Z	75% Y	75% Z	100% Y	100% Z
	5	1.35	-.971	1.37	-1.20	1.38	-1.34	1.38	-1.49
	9	1.90	8.10	1.93	7.31	1.95	7.01	1.97	6.72
	13	1.91	5.19	1.93	4.89	1.95	4.77	1.97	4.65
	17	1.81	4.74	1.84	4.44	1.86	4.33	1.87	4.22
	21	1.72	4.51	1.74	4.20	1.76	4.09	1.77	3.96
	25	1.62	4.37	1.65	4.05	1.66	3.92	1.67	3.80

Damage - Joint 15

Load Joint	30% Y	30% Z	50% Y	50% Z	75% Y	75% Z	100% Y	100% Z
5	.998	.991	1.0	.977	1.0	.969	1.0	.961
9	1.0	.890	1.0	.933	1.0	.949	1.01	.965
13	1.04	1.16	1.04	1.17	1.04	1.18	1.05	1.18
17	1.16	1.42	1.17	1.67	1.18	1.66	1.18	1.65
21	1.21	1.96	1.22	1.91	1.23	1.89	1.24	1.87
25	1.22	2.11	1.23	2.04	1.24	2.01	1.24	1.98

Damage - Joint 23

Load Joint	30% Y	30% Z	50% Y	50% Z	75% Y	75% Z	100% Y	100% Z
5	1.0	1.0	1.0	.976	1.0	.961	1.0	.946
9	1.0	1.0	1.0	1.03	1.0	1.05	1.0	1.07
13	1.0	1.0	1.0	1.03	1.0	1.04	1.0	1.05
17	1.0	.982	1.0	1.01	1.0	1.02	1.0	1.04
21	1.01	1.06	1.01	1.09	1.02	1.10	1.02	1.11
25	1.09	1.36	1.09	1.37	1.10	1.37	1.10	1.37

TABLE 6d. Ratio of Damaged Displacement to Undamaged Displacements on Longeron Opposite Damage Criteria

MODEL 3 $r_i = \frac{DD}{UD}$, i = y,z.

Lower Left Longeron (view from rear)	Load Joint	30% Y	30% Z	50% Y	50% Z	75% Y	75% Z	100% Y	100% Z
Damage - Joint 8									
	6	1.15	.847	1.17	.806	1.18	.785	1.18	.761
	10	1.30	2.32	1.46	2.29	1.53	2.27	1.62	2.26
	14	.865	1.57	.724	1.60	.659	1.61	.594	1.63
	18	.975	1.48	.921	1.51	.895	1.52	.869	1.53
	22	.991	1.44	.958	1.46	.941	1.47	.925	1.48
	26	.997	1.41	.973	1.43	.962	1.44	.949	1.44
Damage - Joint 16									
	6	.994	.987	.996	.973	.997	.966	.997	.958
	10	1.12	.914	1.13	.961	1.14	.977	1.14	.994
	14	1.19	.857	1.16	.904	1.14	.929	1.12	.941
	18	1.68	.374	1.64	.508	1.62	.561	1.60	.614
	22	1.65	.100	1.61	.289	1.59	.362	1.58	.435
	26	1.57	.017	1.55	.201	1.53	.284	1.52	.367
Damage - Joint 24									
	6	1.0	1.0	1.0	.987	1.0	.980	1.0	.973
	10	1.0	1.0	1.02	1.04	1.04	1.06	1.05	1.07
	14	1.0	1.0	.970	1.02	.956	1.04	.942	1.05
	18	.983	.989	.968	1.02	.961	1.03	.955	1.04
	22	1.03	.916	1.02	.963	1.01	.981	1.01	1.0
	26	1.21	.549	1.20	.665	1.19	.797	1.18	.753

for each individual element is calculated in NASTRAN according to the relations given in Table 1. Buckling due to compressive stress occurs before failure of an element due to tension. An additional 20% safety factor is included for compressive stress limits. A margin of safety less than zero indicates failure. A margin of safety between zero and one indicates structural integrity and is acceptable. Margin of safety greater than one is preferred for the purposes of this study.

Members in tension have been found to have margins of safety (M.S.) greater than one for all the models. Since the major changes in M.S. only occur locally, only the neighborhood of the damage criterion joint in question is presented in the tables for the models.

Key for Tables 7 through 12

I.D. = interior diagonal; O.D. = outside diagonal

T.H. = transverse horizontal; T.V. = transverse vertical

T.D. = transverse diagonal; Long. = longeron

J-J = joint-to-joint connection

D = deleted member; T = member in tension

\- = Nonexistant member; Blank space = compressive

Margin of Safety greater than 10.0.

The highly redundant and densely populated model 1 results give the highest margins of safety. The number of elements that have M.S. under ten are few. Tables 7, 8, and 9 present a list of compressive margins of safety under 10.0 for model 1 with damage conditions giving member number, type, and damage condition for the 100% loading condition. Model 1 does not have any margin of safety of less than 1.0.

Models 2 and 3, as explained before, are identical except model 3 has the interior diagonals included. In modeling these structures, elements have a one to one correspondence for ease in comparison (see Appendix D). Therefore, results of models 2 and 3 will be shown together for their margins of safety under 10.0 in Tables 10 through 12. Model 2 produces four cases where the margin of safety drops under 1.0 when damage is imposed. Model 3 has two cases where margin of safety is under 1.0. These cases are displayed in Table 13 where the two structures are presented together with their respective M.S. for different loading conditions. Figures 10 through 15 locate the members in the truss models whose M.S. falls under 1.0

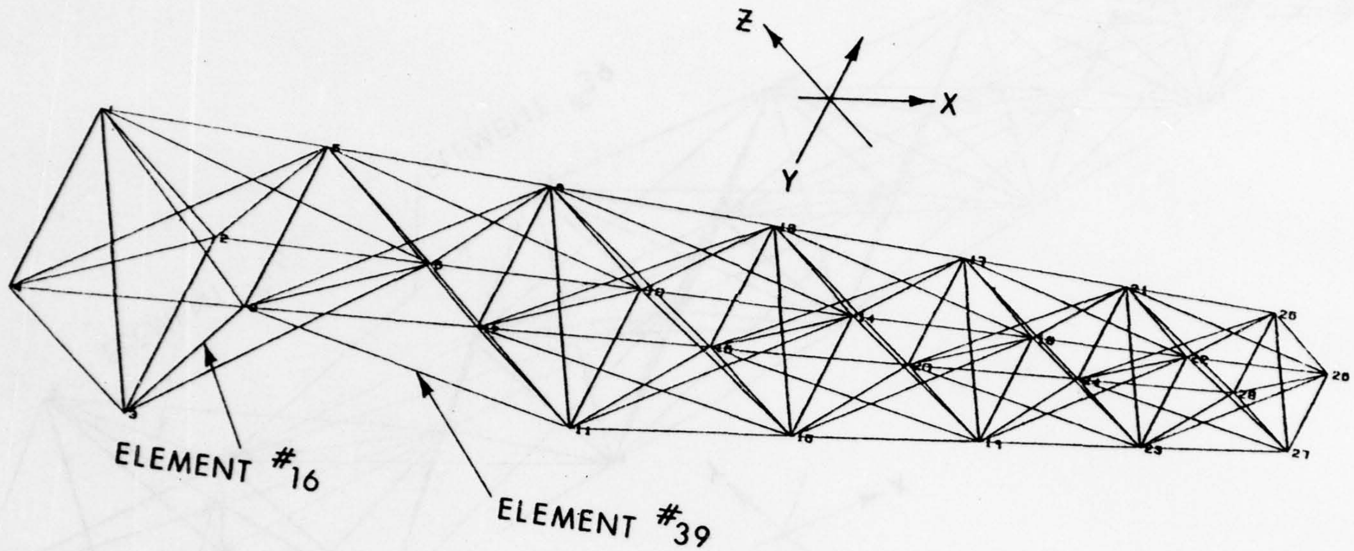

Figure 10.Computer Drawing of Model 2 with Damage of - Joint 7

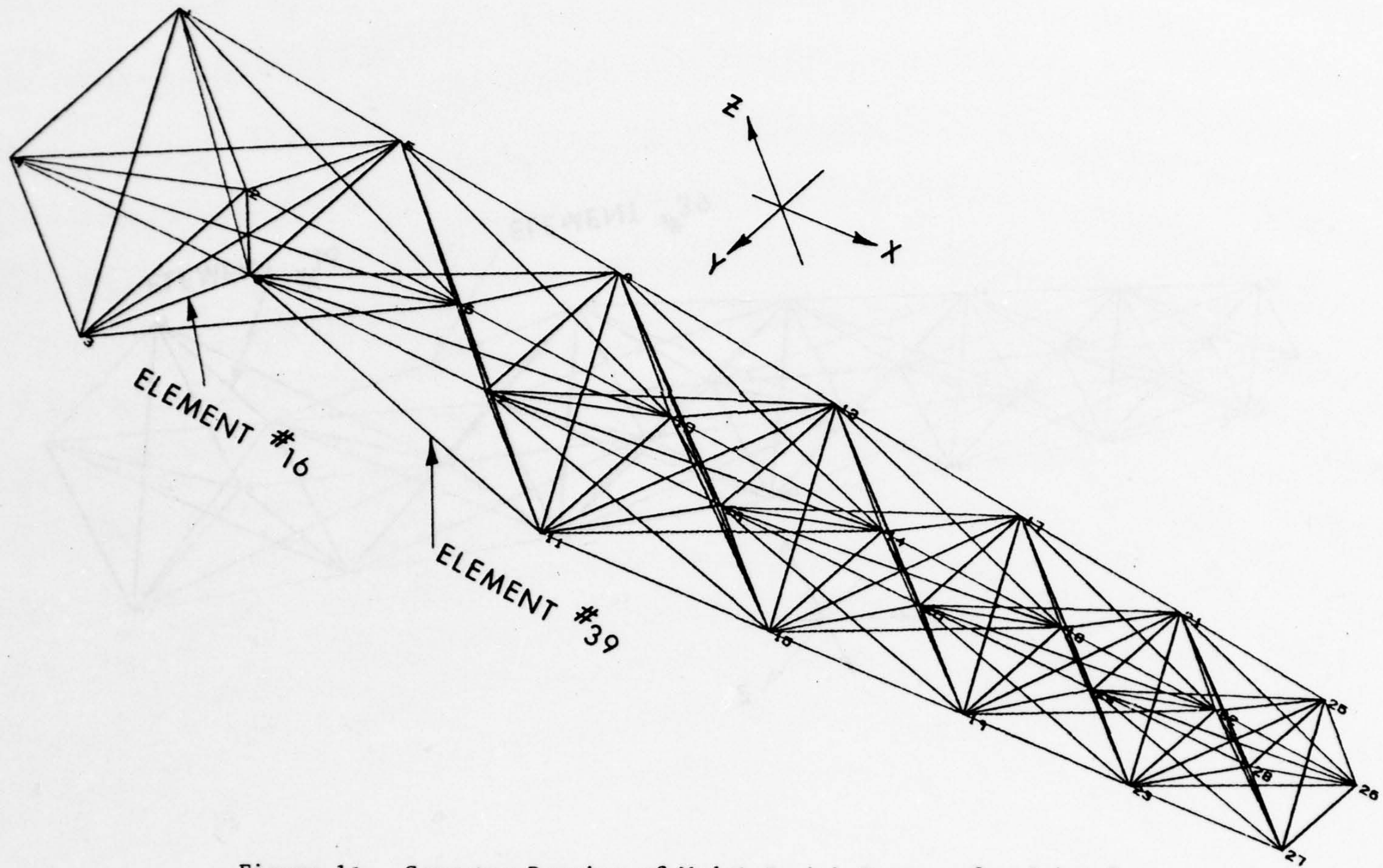

Figure 11. Computer Drawing of Model 3 with Damage of - Joint 7

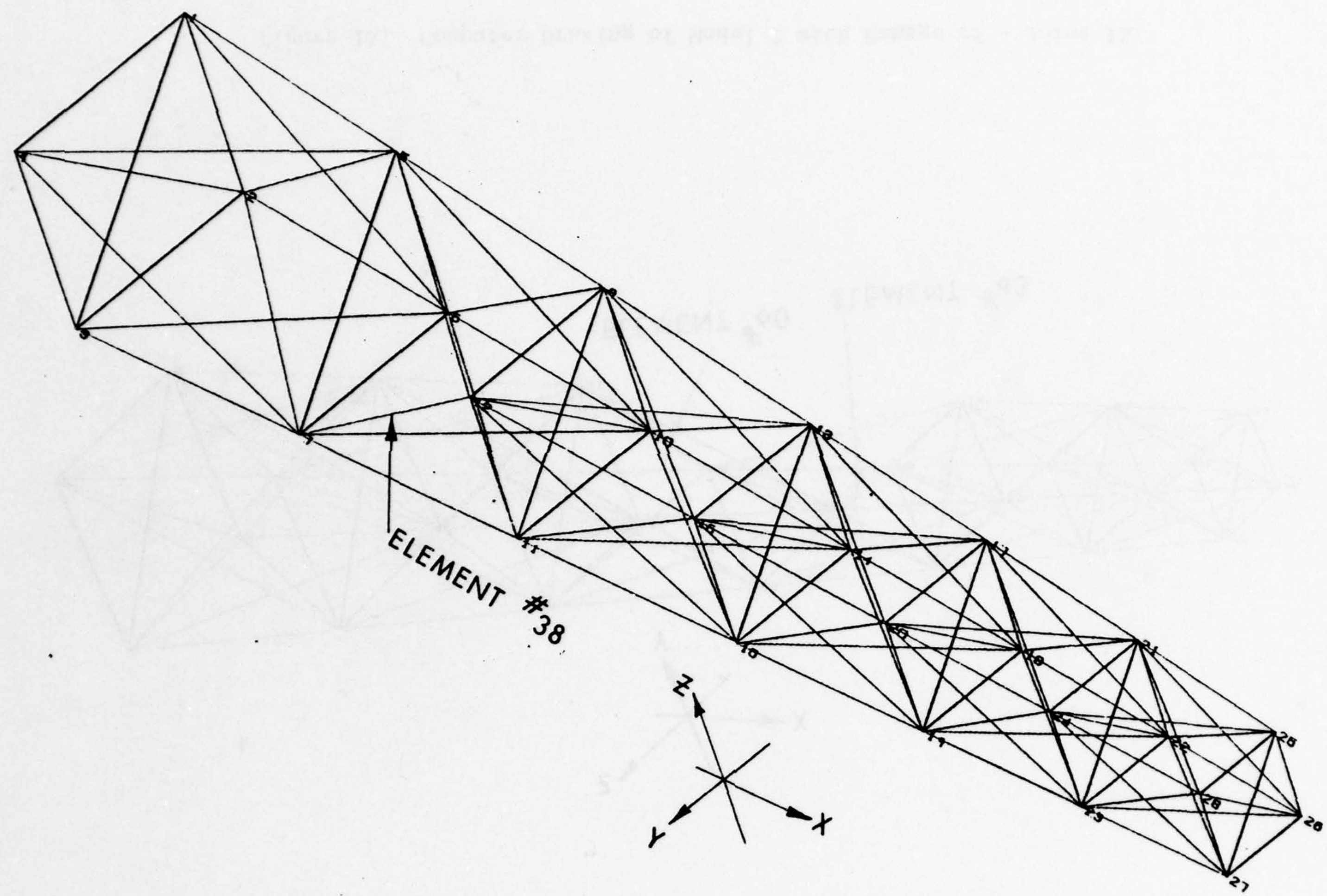

Figure 12. Computer Drawing of Model 2 with Damage of - Joint 8

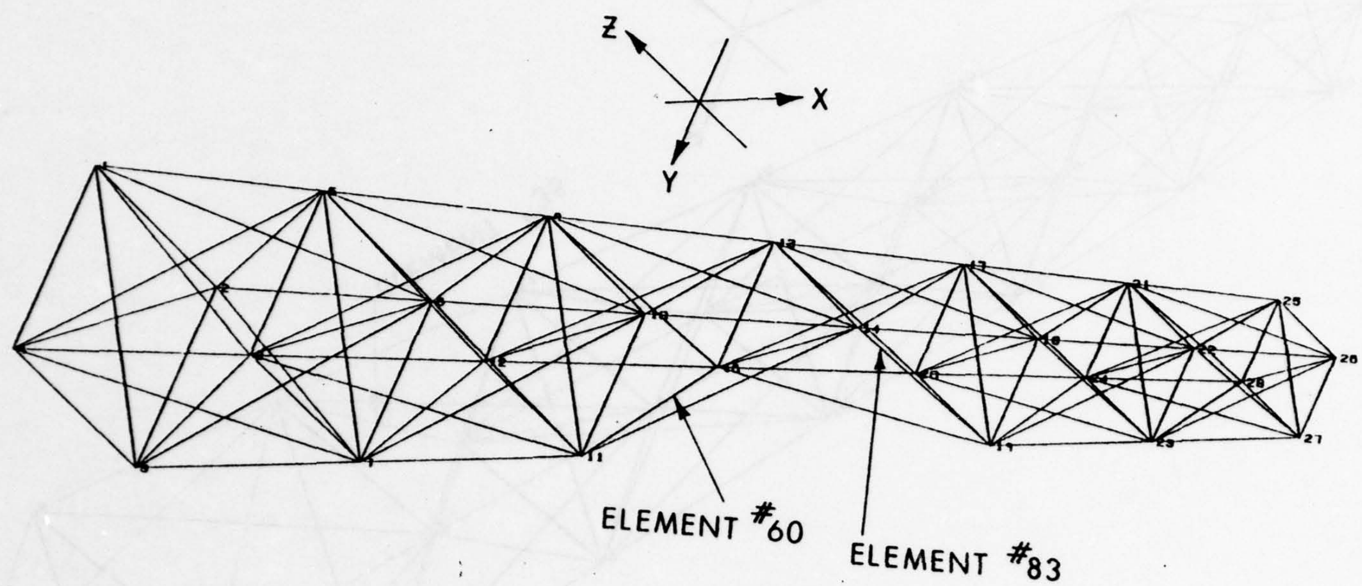

Figure 13. Computer Drawing of Model 2 with Damage of - Joint 15

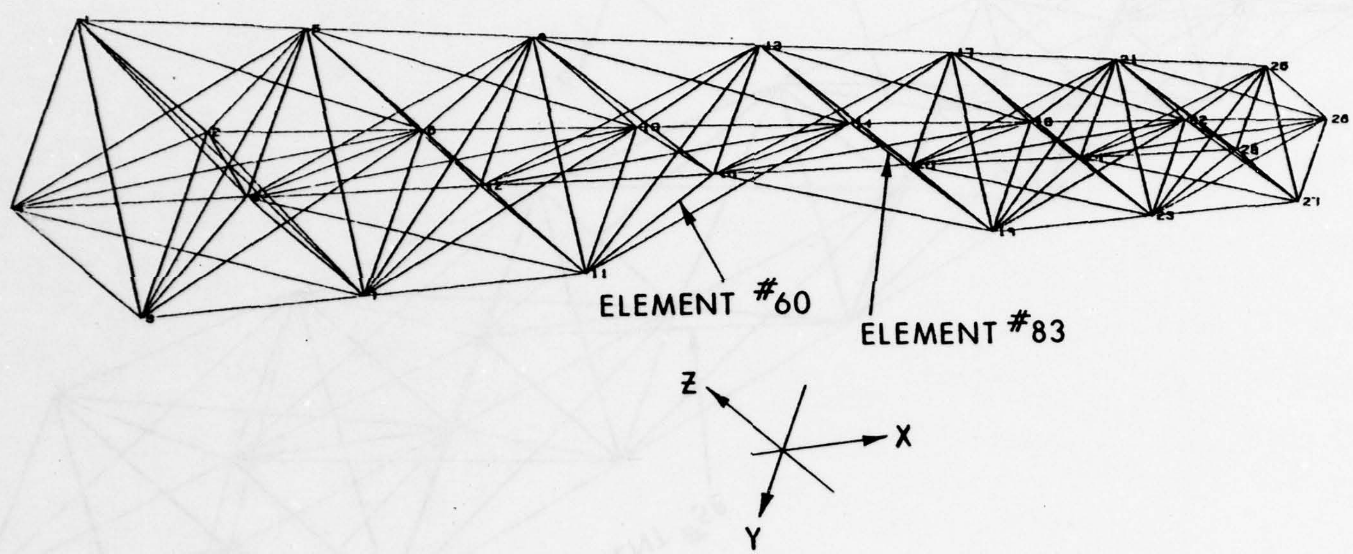

Figure 14. Computer Drawing of Model 3 with Damage of - Joint 15

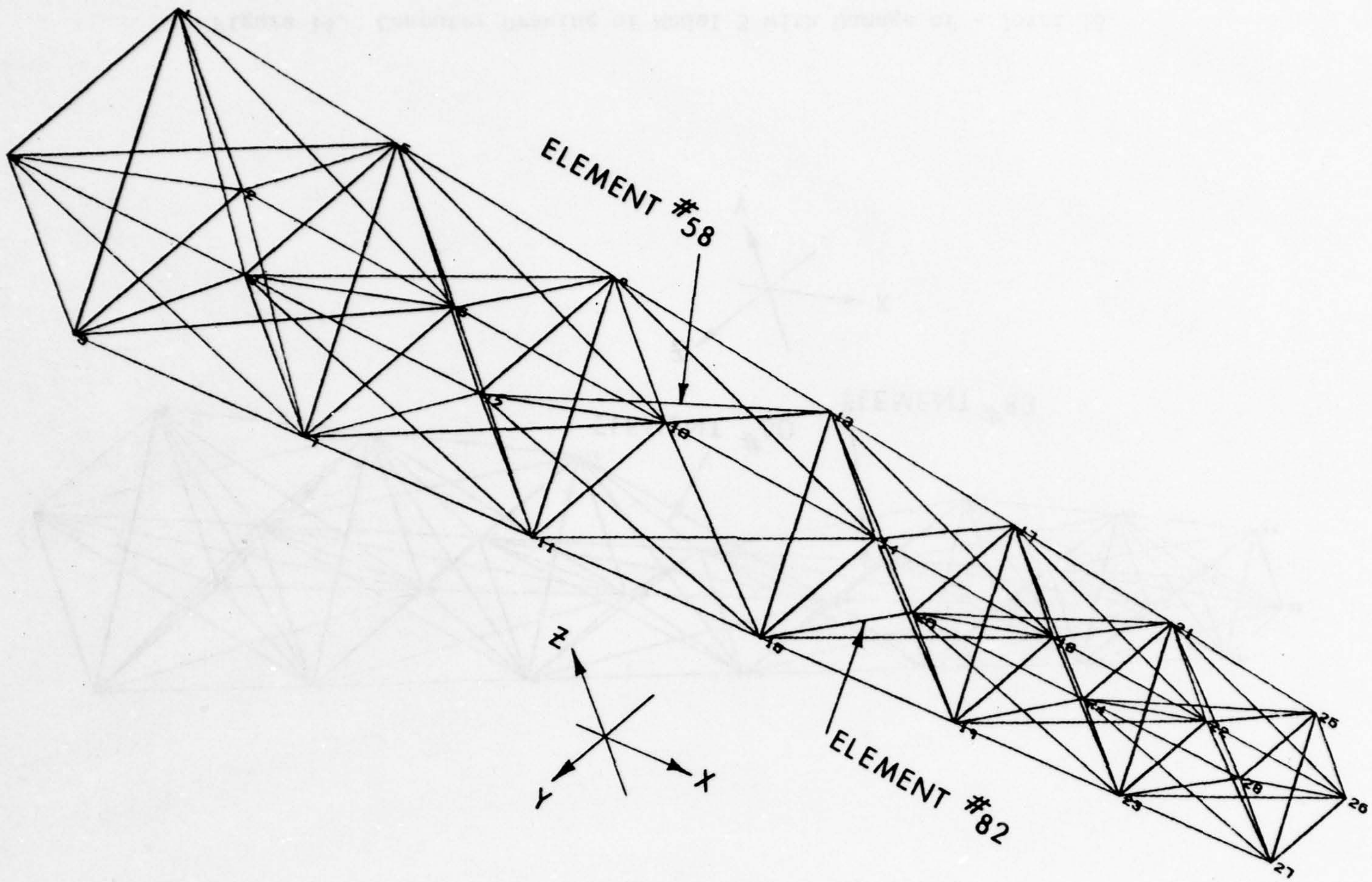

Figure 15. Computer Drawing of Model 2 with Damage of - Joint 16

TABLE 7

Compressive Margins of Safety Under 10.0 Due to 130 knot Flight Load on Forward Vertical Sta with 100% Loading

DAMAGE MODEL 1 MEMBER	J-J	No#	None	Joint 5	Joint 6	Joint 7	Joint 8
Long.	1-5	7	T	D	T	T	T
"	2-6	8		T	D	4.3	
"	3-7	9	6.7	2.7	6.4	D	5.5
"	4-8	10	T	T	T		D
O.D.	1-6	11			D	4.8	
"	2-5	12	T	D	T	T	T
"	1-8	13	T	T	T	T	D
"	4-5	14		D		T	6.6
"	4-7	15	T	T	T	D	T
"	3-8	16	5.1	6.9	5.1	2.2	D
"	2-7	17	4.5	3.2	3.3	D	3.4
"	3-6	18	T	T	D	T	T
I.D.	1-7	19	T	T		D	T
"	2-8	20		T		7.6	D
"	3-5	21		D	T		6.9
"	4-6	22	T		T	T	T
T.V.	5-6	23		D	D		
T.H.	5-8	24		D			D
T.V.	7-8	25	T	T	T	D	D
T.H.	6-7	26	T	T	D	D	T
T.D.	5-7	27		D	T	D	
"	6-8	28		3.7	D	T	D
Long.	5-9	29	T	D	T	T	T
"	6-10	30	T	T	D		
"	7-11	31	8.1	3.7	5.3	D	
"	8-12	32	T	T	T	8.4	D
O.D.	5-10	33		D	5.6		
"	6-9	34	T	T	D	T	T
"	5-12	35	T	D	T	T	T
"	8-9	36				5.1	D
"	8-11	37	T	T	T	T	D
"	7-12	38	5.3	3.3	3.8	D	4.1
"	6-11	39	6.2	9.3	D	2.6	5.4
"	7-10	40	T	T	T	D	T
I.D.	5-11	41	T	D	10.		T
"	6-12	42		T	D	9.7	
"	8-10	44	T		T	T	D

TABLE 8

Compressive Margins of Safety Under 10.0 Due to 130 knot Flight Load on Middle Vertical Sta with 100% Loading

DAMAGE MODEL 1 MEMBER	J-J	No#	None	Joint 21	Joint 22	Joint 23	Joint 24
Long.	17-21	95	T	D	T	T	T
"	18-22	96	T	T	D		T
"	19-23	97		10.		D	8.6
"	20-24	98					D
O.D.	17-22	99			D	8.9	
"	18-21	100	T	D	T	T	T
"	17-24	101	T	T	T	T	D
"	20-21	102		D			5.5
"	20-23	103	T	T	T	D	T
"	19-24	104	7.1	7.3	5.6	3.8	D
"	18-23	105		7.5	8.6	D	6.0
"	19-22	106	T	T	D	T	T
I.D.	17-23	107	T			D	T
"	18-24	108		T			D
"	19-21	109	T	D	T	T	
"	20-22	110	T		D	T	T
T.V.	21-22	111		D	D		
T.H.	21-24	112		D	T		D
T.V.	23-24	113	T	T	T	D	D
T.H.	22-23	114		T	D	D	
T.D.	21-23	115		D		D	T
"	22-24	116			D	T	D
Long.	21-25	117	T	D	T	T	
"	22-26	118	T	T	D	T	T
"	23-27	119				D	
"	24-28	120		T			D
O.D.	21-26	121		D	9.9		9.2
"	22-25	122	T	T	D	T	T
"	21-28	123	T	D	T	T	T
"	24-25	124			9.6	7.7	D
"	24-27	125	T	T	T	T	D
"	23-28	126	8.8	6.6	8.3	D	5.0
"	22-27	127			D	5.5	
"	23-26	128	T	T	T	D	T
I.D.	21-27	129		D			T
"	22-28	1-0	T	T	D		
"	23-25	131		T	T	D	
"	24-26	132	T		T	T	D

TABLE 9
Compressive Margins of Safety Under 10.0 Due to 130 knot
Flight Load on End Vertical Sta with 100% Loading

DAMAGE MODEL 1 MEMBER	J-J	No#	None	Joint 37	Joint 38	Joint 39	Joint 40
Long.	33-37	183	T	D	T	T	T
"		184	T	T	D		T
"		185			T	D	
"		186					D
O.D.		187			D		
"		188	T	D	T	T	T
"		189	T	T	T	T	D
"		190		D			8.0
"		191	T	T	T	D	T
"		192	7.2	7.8	5.6	4.0	D
"		193				D	8.9
"		194	T	T	D	T	T
I.D.		195		T		D	T
"		196		T	T		D
"		197	T	D	T		
"		198	T		D	T	
T.V.		199		D	D		
T.H.		200		D	T		D
T.V.		201	T	T	T	D	D
T.H.		202	T	T	D	D	T
T.D.		203	T	D		D	T
T.D.		204			D	T	D
Long.		205	T	D	T	T	T
"		206	T	T	D	T	T
"		207				D	
"		208		T			D
O.D.		209		D			
"		210	T	T	D	T	T
"		211	T	D	T	T	T
"		212				9.4	D
"		213	T	T	T	T	D
"		214		8.1		D	5.9
"		215			D	7.3	
"		216	T	T	T	D	T
I.D.		217		D			T
"		218	T	T	D		
"		219		T	T	D	
"		220	T		T	T	D

TABLE 10

Compressive Margins of Safety Under 10.0 Due to 130 knot Flight Load on Forward Vertical Sta with 100% Loading for Models 2 and 3

DAMAGE			None		Joint 5		Joint 6		Joint 7		Joint 8	
MODEL			2	3	2	3	2	3	2	3	2	3
MEMBER	J-J	No.#										
Long.	1-5	7	T	T	D	D	T	T	T	T	T	T
"	2-6	8			T	T	D	D	2.0	2.3		
"	3-7	9	3.6	3.6	1.4	1.3	4.1	4.1	D	D	1.9	2.2
"	4-8	10	T	T	T	T	T	T			D	D
O.D.	1-6	11		8.0	8.4	10.	D	D	2.8	2.2		7.1
"	2-5	12	T	T	D	D	T	T	T	T	T	T
"	1-8	13	T	T	T	T	T	T	T	T	D	D
"	4-5	14			D	D	8.7	7.6	T	T	1.6	3.0
"	4-7	15	T	T	T	T	T	T	D	D	T	T
"	3-8	16	2.0	2.2	2.8	2.6	2.3	2.3	.36	.71	D	D
"	2-7	17	2.0	2.0	1.5	1.3	1.2	1.4	D	D	1.5	1.2
"	3-6	18	T	T	T	T	D	D	T	T	T	T
I.D.	1-7	19	-	T	-	T	-		-	D	-	T
"	2-8	20	-		-	T	-		-	3.2	-	D
"	3-5	21	-		-	D	-	T	-		-	3.7
"	4-6	22	-	T	-		-	D	-	T	-	T
T.V.	5-6	23			D	D	D	D				
T.H.	5-8	24			D	D					D	D
T.V.	7-8	25	T	T	T	T	T	T	D	D	D	D
T.H.	6-7	26	T	T	T	T	D	D	D	D	T	T
T.D.	5-7	27	T		D	D	T	T	D	D		
"	6-8	28			4.0	3.5	D	D	T	T	D	D
Long.	5-9	29	T	T	D	D	T	T	T	T	T	T
"	6-10	30	T	T	T	T	D	D				T
"	7-11	31	4.4	4.4	1.8	1.8	1.9	2.2	D	D		8.5
"	8-12	32			T	T	T		2.5	3.1	D	D
O.D.	5-10	33	8.6	7.0	D	D	1.6	2.4	T		6.9	4.9
"	6-9	34	T	T	T	T	D	D	T	T		T
"	5-12	35	T	T	D	D	T	T	T	T	T	T
"	8-9	36	6.0	5.7	3.7	5.6		5.7	2.2	1.9	D	D
"	8-11	37	T	T.	T	T	T	T	T	T	D	D
"	7-12	38	1.7	1.9	1.3	1.1	1.2	1.1	D	D	.81	1.2
"	6-11	39	2.3	2.3	3.1	2.6	D	D	.44	.79	2.6	2.1
"	7-10	40	T	T	T	T	T	T	D	D	T	T
I.D.	5-11	41	-	T	-	D	-	5.1	-	T	-	T
"	6-12	42	-		-	T	-	D	-	3.0	-	
"	7-9	43	-		-		-	T	-	D	-	7.5
"	8-10	44	-	T	-		-	T	-	T	-	D

TABLE 11
Compressive Margins of Safety Under 10.0 Due to 130 knot
Flight Load on Middle Vertical Sta with 100% Loading
for Models 2 and 3

DAMAGE			None		Joint 13		Joint 14		Joint 15		Joint 16	
MODEL			2	3	2	3	2	3	2	3	2	3
MEMBER	J-J	No.#										
Long.	9-13	51	T	T	D	D	T	T	T	T	T	T
"	10-14	52	T	T	T	T	D	D	5.1	7.5	T	T
"	11-15	53	6.2	6.2	3.0	3.0	T	T	D	D	1.5	1.9
"	12-16	54			7.6	8.5	5.6	6.1			D	D
O.D.	9-14	55	7.0	5.6	2.5	3.7	D	D	2.9	2.2	T	8.4
"	10-13	56	T	T	D	D	T	T	T	T	T	T
"	9-16	57	T	T	T	T	T	T	T	T	D	D
"	12-13	58	3.5	3.4	D	D	3.8	3.0	10.	4.7	.62	1.1
"	12-15	59	T	T	T	T	T	T	D	D	T	T
"	11-16	60	1.3	1.5	1.3	1.2	1.3	1.2	.24	.56	D	D
"	10-15	61	2.3	2.3	2.2	1.7	1.2	1.7	D	D	1.2	1.0
"	11-14	62	T	T	T	T	D	D	T	T	T	T
I.D.	9-15	63	-	T	-	T	-		-	D	-	T
"	10-16	64	-		-	T	-		-	3.2	-	D
"	11-13	65	-		-	D	-	T	-		-	2.9
"	12-14	66	-	T	-		-	D	-	T	-	T
T.V.	13-14	67			D	D	D	D				
T.H.	13-16	68			D	D	T	T			D	D
T.V.	15-16	69	T	T	T	T	T	T	D	D	D	D
T.H.	14-15	70	T	T	T	T	D	D	D	D		
T.D.	13-15	71			D	D			D	D	T	T
"	14-16	72					D	D	T	T	D	D
Long.	13-17	73	T	T	D	D	T	T	T	T		
"	14-18	74	T	T	T	T	D	D	T	T	T	T
"	15-19	75	9.8	9.9	4.8	4.9	4.7	5.7	D	D		
"	16-20	76			T	T	5.9	5.8	2.6	3.1	D	D
O.D.	13-18	77	5.4	5.4	D	D	1.7	2.9		7.2	3.2	2.8
"	14-17	78	T	T	T	T	D	D	T	T	T	T
"	13-20	79	T	T	D	D	T	T	T	T	T	T
"	16-17	80	4.0	3.9	2.1	2.9	4.8	3.0	2.2	1.9	D	D
"	16-19	81	T	T	T	T	T	T	T	T	D	D
"	15-20	82	2.3	2.3	2.3	1.8	2.1	1.7	D	D	.87	1.2
"	14-19	83	3.3	3.4	3.3	2.8	D	D	.82	1.3	5.5	4.1
"	15-18	84	T	T	T	T	T	T	D	D	T	T
T.D.	13-19	85	-		-	D	-	5.9	-		-	T
"	14-20	86	-		-	T	-	D	-	4.2	-	
"	15-17	87	-	T	-	T	-	T	-	D	-	7.3
"	16-18	88	-	T	-		-	T	-	T	-	D

TABLE 12
Compressive Margins of Safety Under 10.0 Due to 130 knot
Flight Load on End Vertical Sta with 100% Loading for Models 2 and 3

DAMAGE			None		Joint 21		Joint 22		Joint 23		Joint 24	
MODEL			2	3	2	3	2	3	2	3	2	3
MEMBER	J-J	No#										
Long.	17-21	95	T	T	D	D	T	T	T	T	T	T
"	18-22	96	T	T	T	T	D	D			T	T
"	19-23	97			5.4	5.6	T	T	D	D	3.2	3.7
"	20-24	98			7.8	9.1	6.6	6.8			D	D
O.D.	17-22	99	6.5	6.5	2.6	4.1	D	D	3.6	3.2		9.1
"	18-21	100	T	T	D	D	T	T	T	T	T	T
"	17-24	101	T	T	T	T	T	T	T	T	D	D
"	20-21	102	5.1	4.9	D	D	5.0	4.1	6.5	6.5	1.4	2.0
"	20-23	103	T	T	T	T	T	T	D	D	T	T
"	19-24	104	2.9	2.9	2.9	2.4	3.0	2.4	1.1	1.5	D	D
"	18-23	105	4.2	4.3	4.1	3.1	2.3	3.3	D	D	2.5	2.2
"	19-22	106	T	T	T	T	D	D	T	T	T	T
I.D.	17-23	107	-		-		-	10.	-	D	-	T
"	18-24	108	-		-	T	-		-	6.7	-	D
"	19-21	109	-	T	-	D	-	T	-	T	-	6.1
"	20-22	110	-	T	-	9.6	-	D	-	T	-	T
T.V.	21-22	111			D	D	D	D				
T.H.	21-24	112			D	D	T	T			D	D
T.V.	23-24	113	T	T	T	T	T	T	D	D	D	D
T.H.	22-23	114			T	T	D	D	D	D		
T.D.	21-23	115		T	D	D			D	D	T	T
T.D.	22-24	116	T				D	D	T	T	D	D
Long.	21-25	117	T	T	D	D	T	T	T	T		
"	22-26	118	T	T	T	T	D	D	T	T	T	T
"	23-27	119			6.7	7.1	5.6	7.4	D	D		
"	24-28	120			T	T	7.8	7.3	3.4	3.9	D	D
O.D.	21-26	121	7.3	7.2	D	D	2.4	4.0			4.1	3.7
"	22-25	122	T	T	T	T	D	D	T	T	T	T
"	21-28	123	T	T	D	D	T	T	T	T	T	T
"	24-25	124	5.0	4.8	2.9	4.0	6.0	3.7	2.9	2.4	D	D
"	24-27	125	T	T	T	T	T	T	T	T	D	D
"	23-28	126	3.1	3.1	2.9	2.3	2.8	2.3	D	D	1.2	1.6
"	22-27	127	4.2	4.4	4.3	3.7	D	D	1.2	1.9	7.4	5.6
"	23-26	128	T	T	T	T	T	T	D	D	T	T
I.D.	21-27	129	-		-	D	-	6.2	-		-	T
"	22-28	130	-	T	-	T	-	D	-	6.3	-	
"	23-25	131	-		-	T	-	T	-	D	-	8.0
"	24-26	132	-	T	-		-	T	-	T	-	D

TABLE 13

Cases of Models 2 and 3 Where M.S. Less Than 1.0

Loading	Element #	J-J	Model 2 M.S.	Model 3 M.S.
Case Where Damage is - Joint 7				
100%	16	3-8	.36	.71
	39	6-11	.44	.79
75%	16	3-8	.82	1.3
	39	6-11	.94	1.4
Case Where Damage is - Joint 8				
100%	38	7-12	.81	1.2
Case Where Damage is - Joint 15				
100%	60	11-16	.24	.56
	83	14-19	.82	1.3
75%	60	11-16	.66	1.1
Case Where Damage is - Joint 16				
100%	58	12-13	.62	1.1
	82	15-20	.87	1.2

3.3 Natural Frequencies

All structures have resonant frequencies. It is important to know these natural frequencies. To find these frequencies NASTRAN has an eigenvalue method, known as rigid format 3 Normal Modes and Frequencies, for extracting a model's natural frequencies. The first three natural frequencies of each complete structure are found with direction. Table 14 lists the frequencies of each model plus the figure that shows the mode shape.

TABLE 14

NATURAL FREQUENCIES

Model 1		
15.67 Hz	FUNDAMENTAL Y	Figure 16 First Mode Shape
16.63 Hz	FUNDAMENTAL Z	Figure 17 Second Mode Shape
76.41 Hz	1st HARMONIC Y	Figure 18 Third Mode Shape
Model 2		
21.62 Hz	FUNDAMENTAL Y	Figure 19 First Mode Shape
22.92 Hz	FUNDAMENTAL Z	Figure 20 Second Mode Shape
88.44 Hz	1st HARMONIC Y	Figure 21 Third Mode Shape
Model 3		
19.30 Hz	FUNDAMENTAL Y	Figure 22 First Mode Shape
20.48 Hz	FUNDAMENTAL Z	Figure 23 Second Mode Shape
77.70 Hz	1st HARMONIC Y	Figure 24 Third Mode Shape

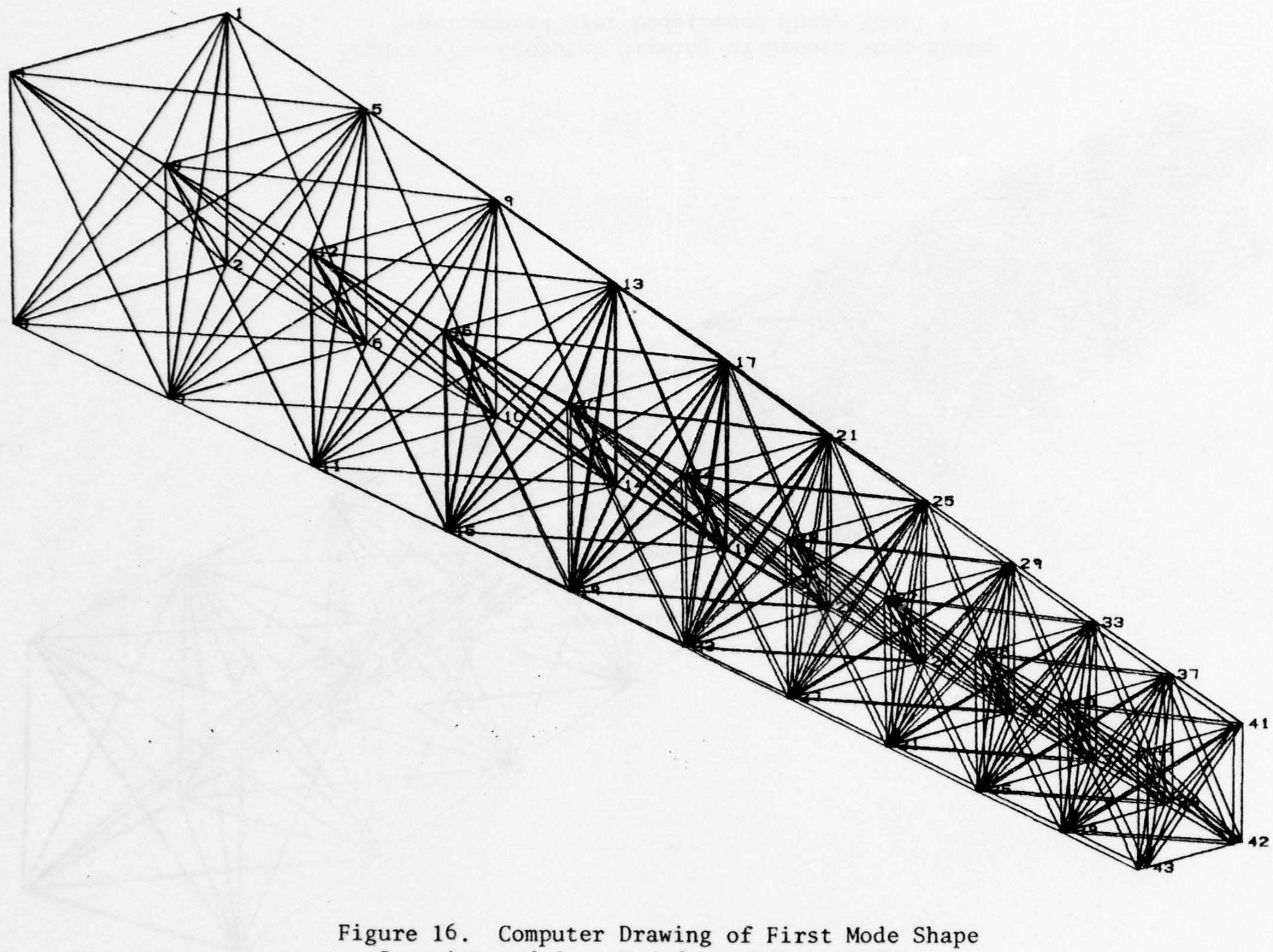

Figure 16. Computer Drawing of First Mode Shape
Superimposed Over Undeformed Shape Model 1

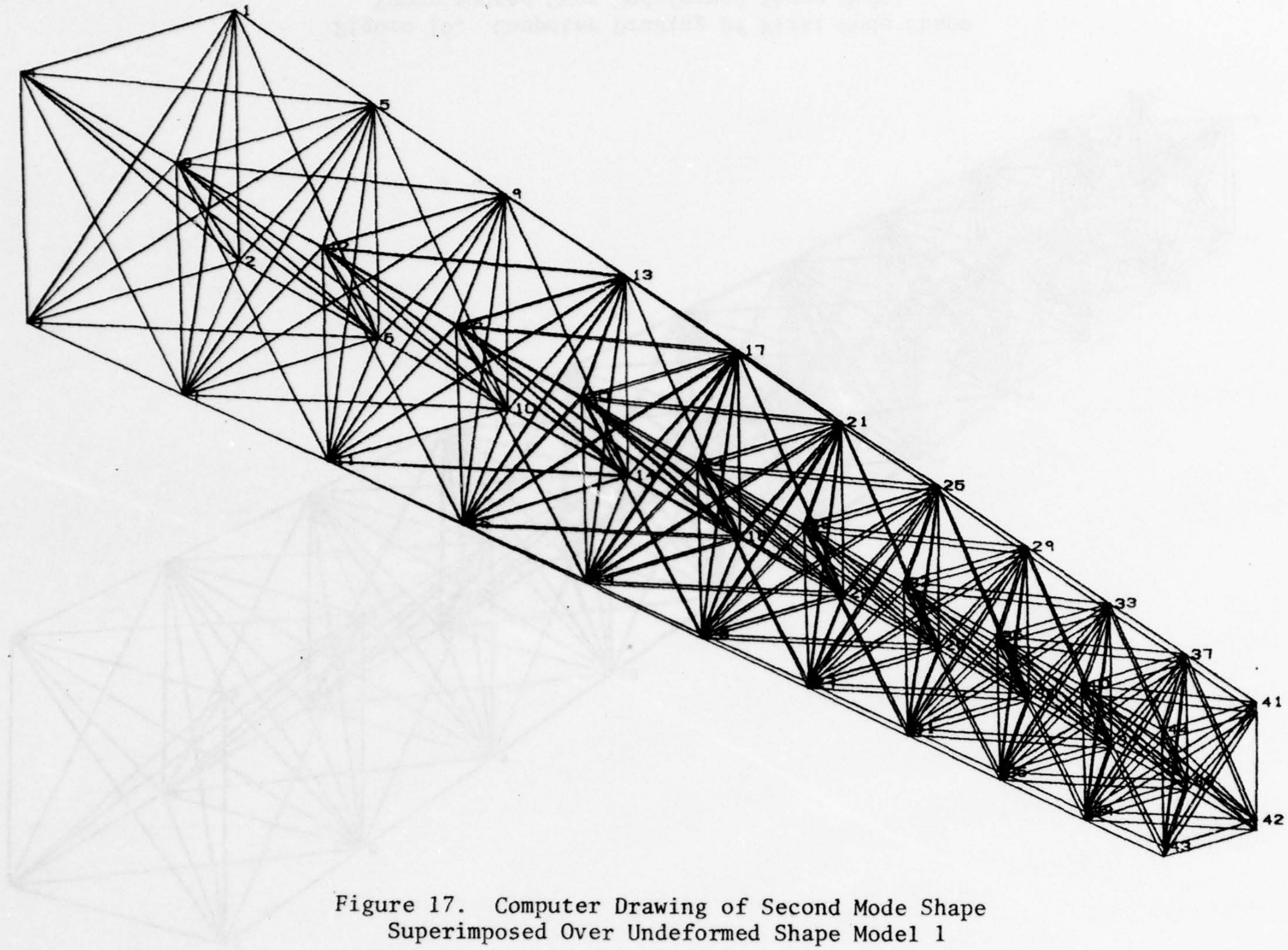

Figure 17. Computer Drawing of Second Mode Shape
Superimposed Over Undeformed Shape Model 1

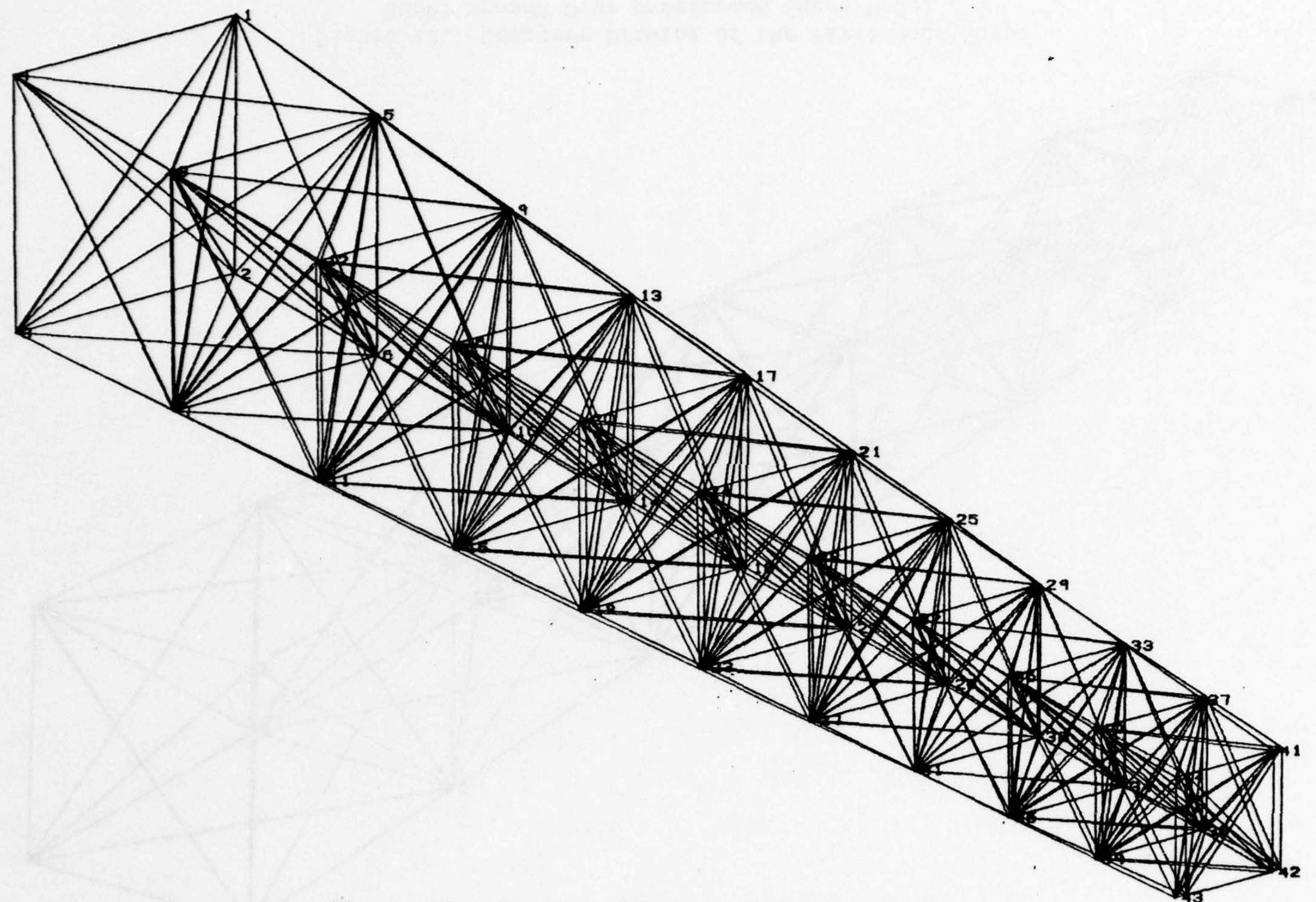

Figure 18. Computer Drawing of Third Mode Shape
Superimposed Over Undeformed Shape Model 1

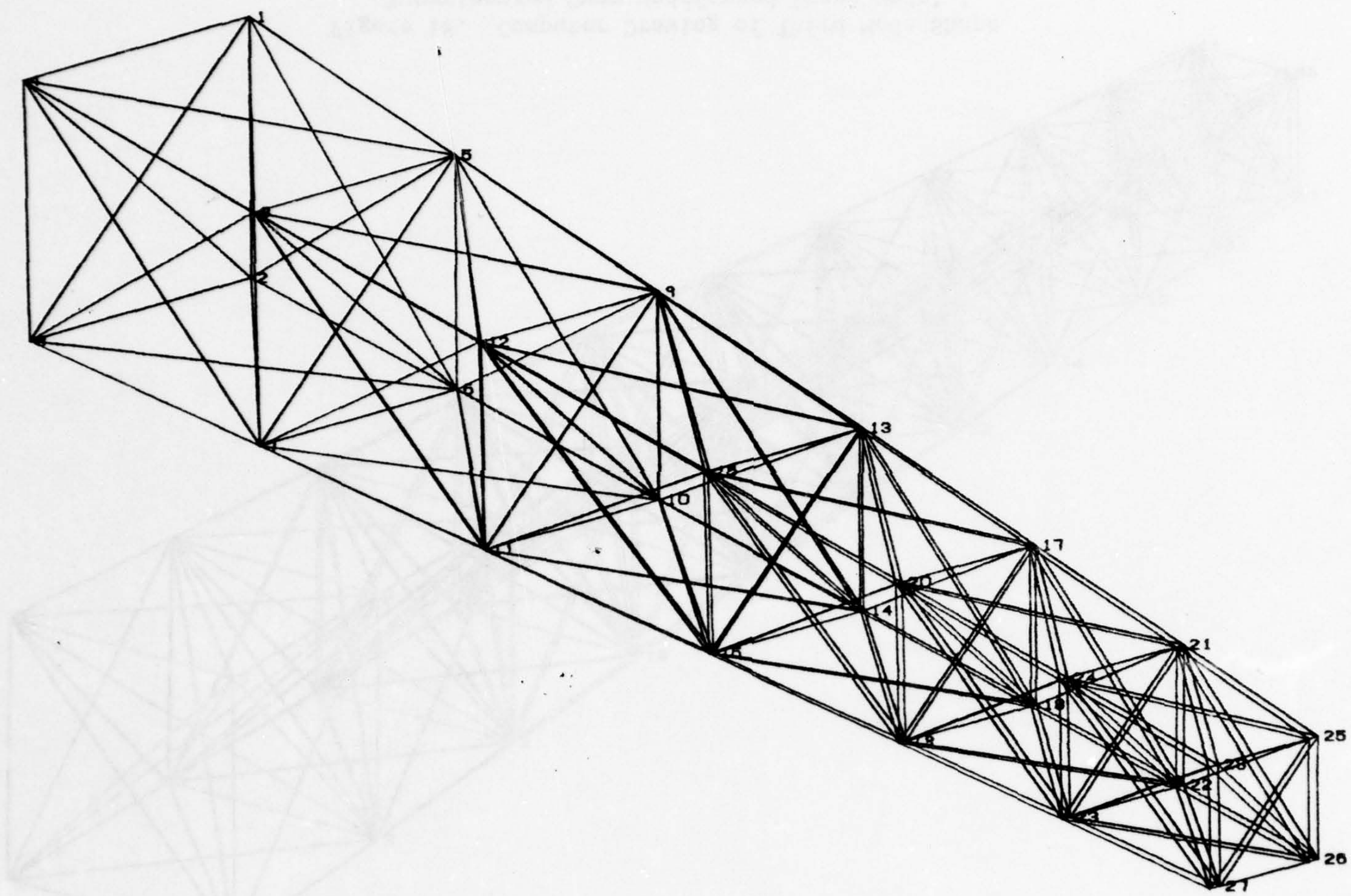

Figure 19. Computer Drawing of the First Mode Shape
Superimposed Over Undeformed Shape Model 2

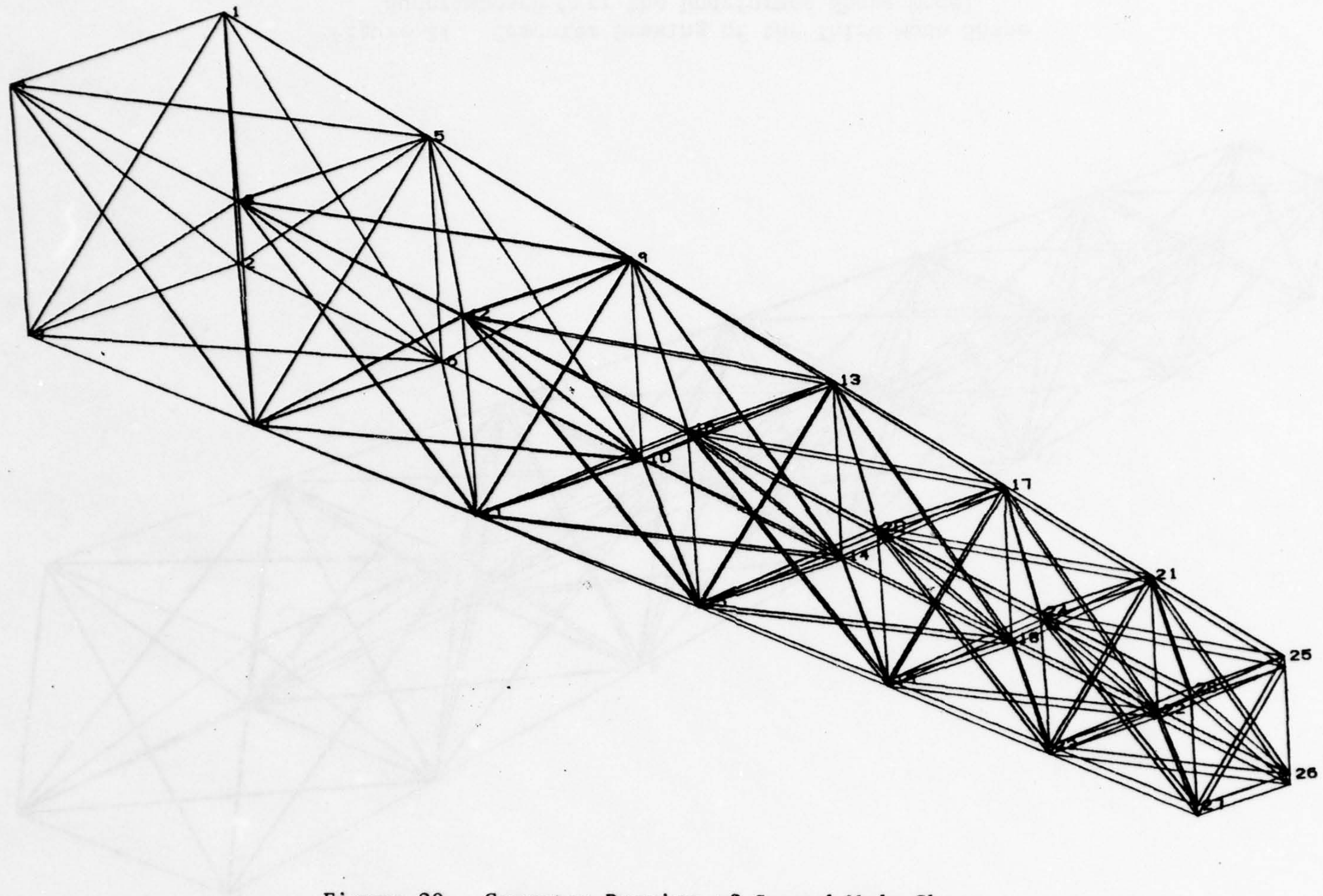

Figure 20. Computer Drawing of Second Mode Shape
Superimposed Over Undeformed Shape Model 2

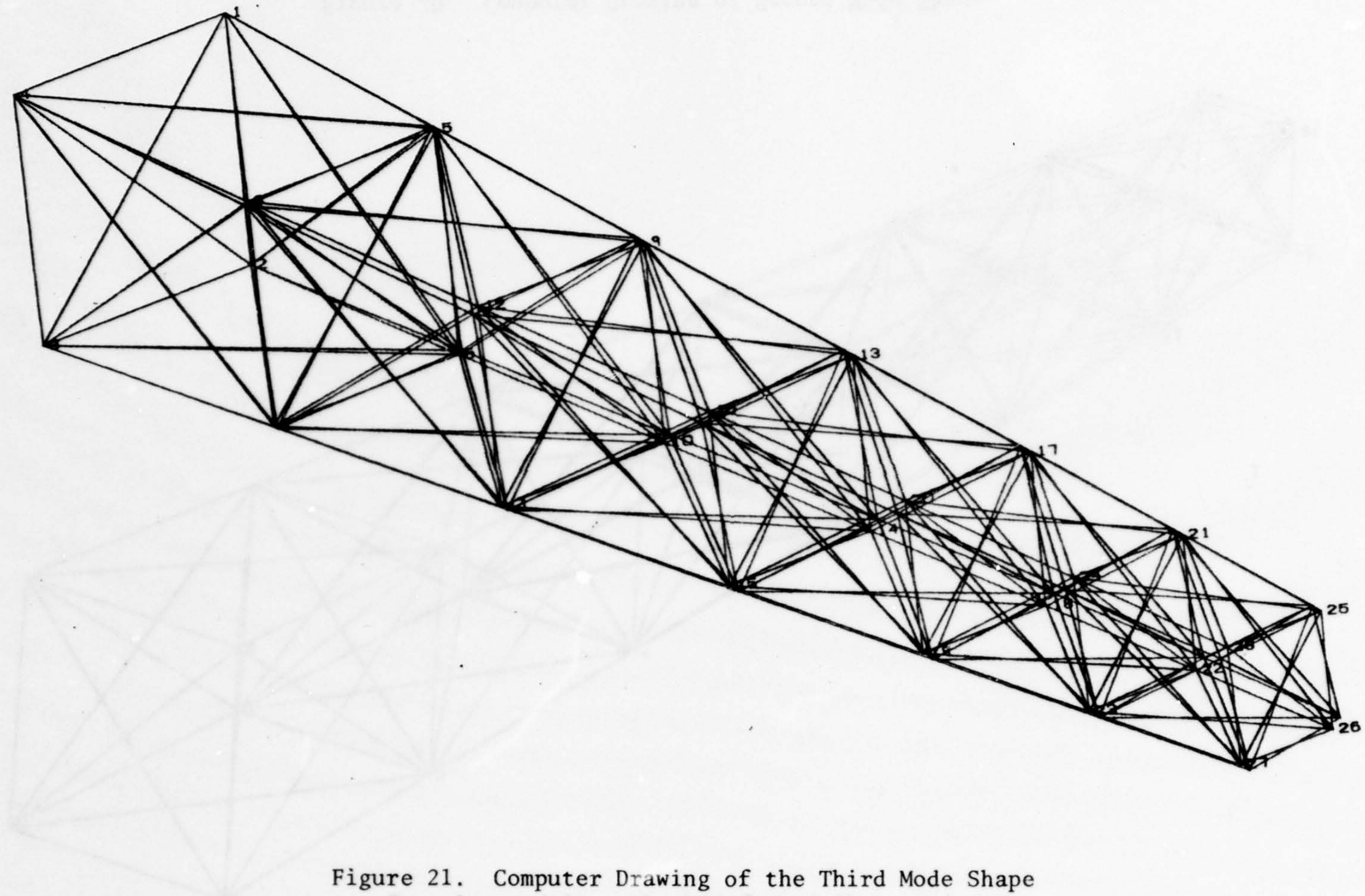

Figure 21. Computer Drawing of the Third Mode Shape Superimposed Over the Undeformed Shape Model 2

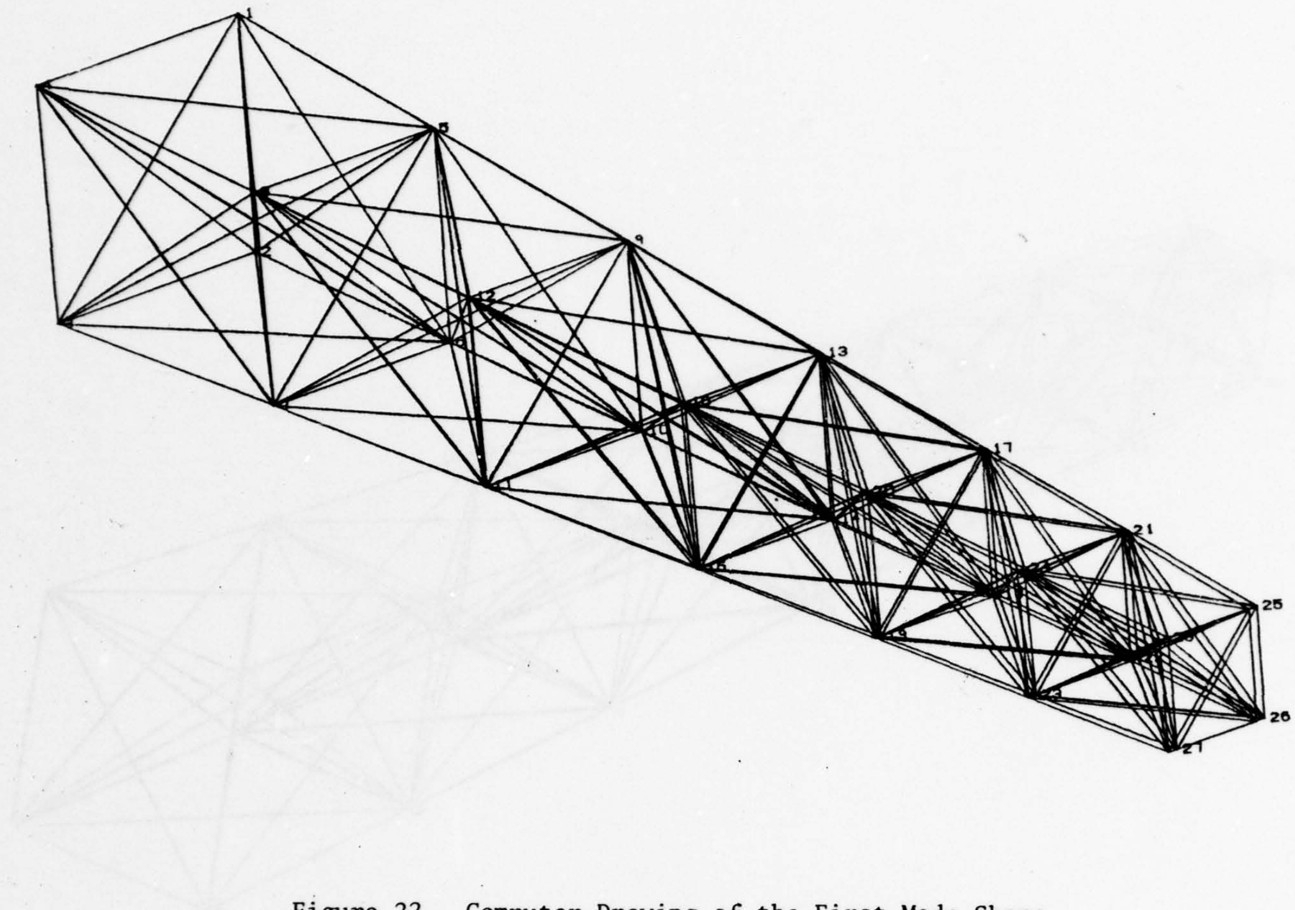

Figure 22. Computer Drawing of the First Mode Shape
Superimposed Over Undeformed Shape Model 3

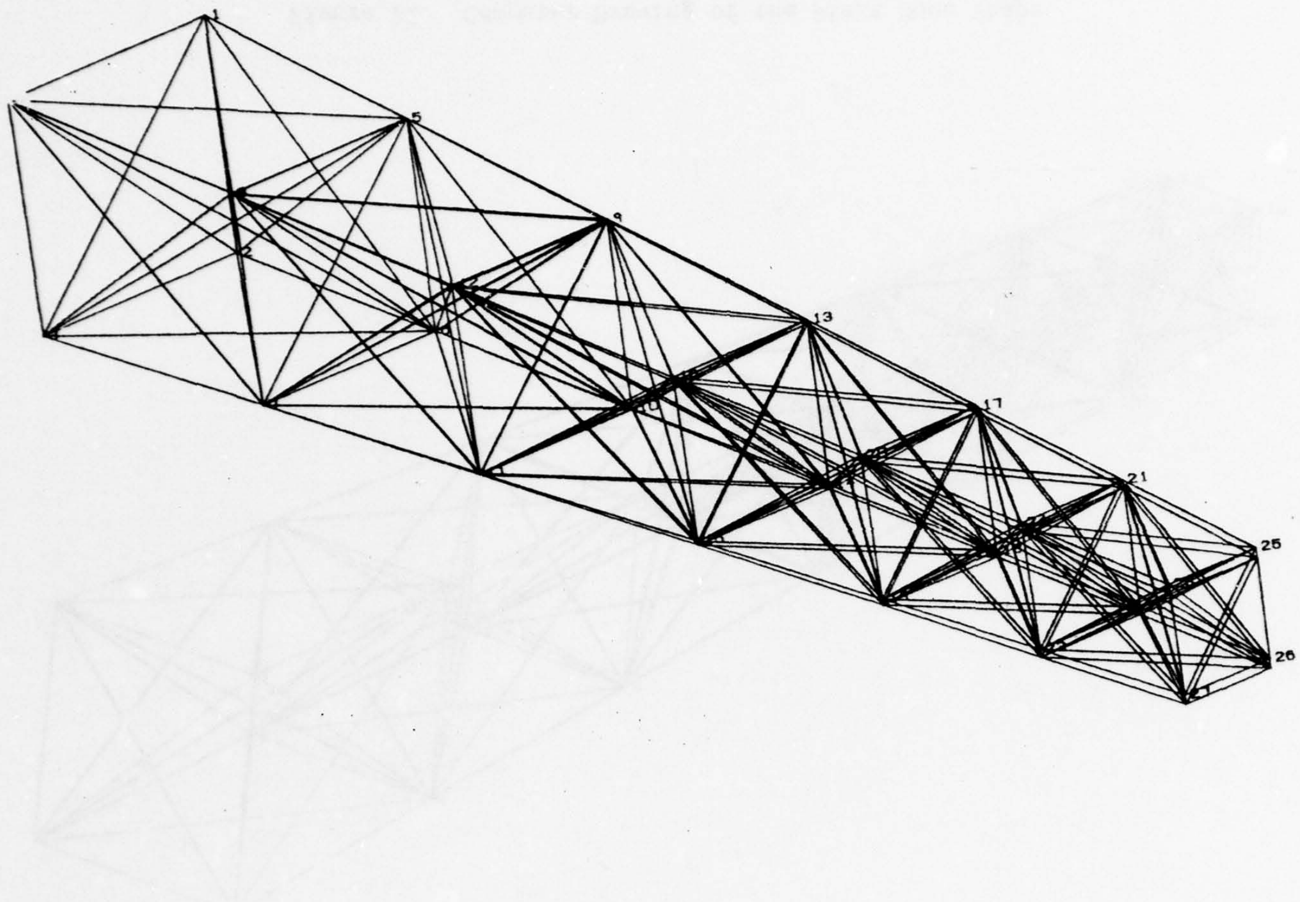

Figure 23. Computer Drawing of Second Mode Shape
Superimposed Over Undeformed Shape Model 3

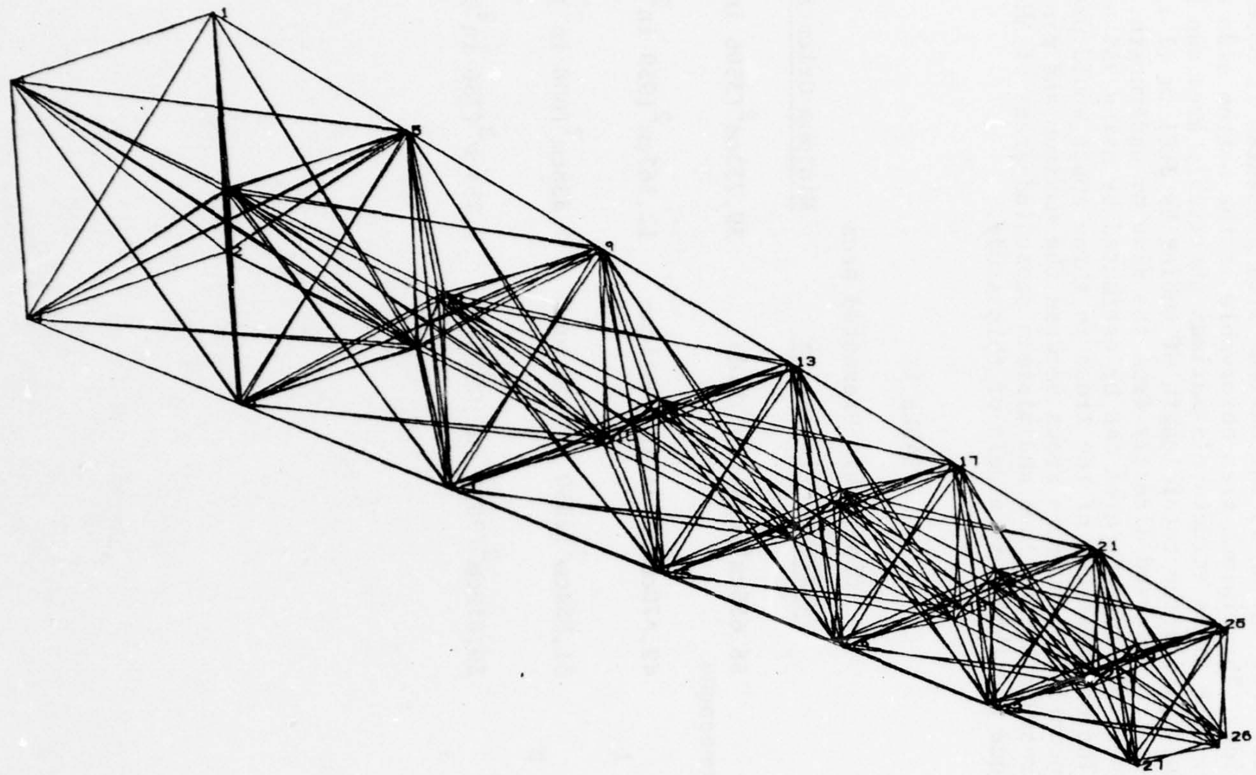

Figure 24. Computer Drawing of the Third Mode Shape
Superimposed Over Undeformed Shape Model 3

3.4 Observable Surface Area

The semimonocoque surface area observed can be considered flat and can be easily calculated by the area of the quadrilateral that presents itself. For the AH-1G the maximum area presented is observed from the side. The minimum area observable is the bottom side directly underneath. The truss structure's maximum observable area can be estimated by multiplying the total length of tubing by 3.81 cm (1 1/2 in). The minimums are observed directly from the side or underneath. The minimum observable surface area can be estimated by using 25% of the maximum. The orientations of the truss in three space would present varying noncontinuous surface areas between the maximum and minimum. Table 15 presents the maximum and minimum presented areas of AH-1G semimonocoque and the truss models of this study.

TABLE 15

Observable Presented Area

	Maximum Orientation	Minimum Orientation
AH-1G Semimonocoque	58,655cm^2(4546 in^2)Side	39,233cm^2(3506 in^2)Bottom
Truss Model 1	49,470cm^2(3834 in^2)Oblique	12,367cm^2(959 in^2)Side
Truss Model 2	31,354cm^2(2430 in^2)Oblique	7,838cm^2(608 in^2)Side
Truss Model 3	39,019cm^2(3024 in^2)Oblique	9,754cm^2(756 in^2)Side

IV. DISCUSSION

The complete semimonocoque tail boom structure weighs approximately 90.72 kg (200 lbs), reference 4, and its deflections due to 130 knot level flight load are 1.37 cm (.539 in) in y direction and .37 cm (.146 in) in the z direction, reference 12. As indicated in Table 3, the maximum displacements for each maximum loading case of the truss models show only a slight difference between the models. Comparing the complete truss models with the complete semimonocoque structure shows the stiffness of the truss models to be 12% greater in the y direction, and 46% less in the z direction. Considering the weight difference between the truss models and the semimonocoque structure, the stiffness of the truss models is reasonably competitive. Table 3 shows that the maximum increase in displacement for the y direction is .82 cm which occurs for unsubstructured model 2 when joint 5 is deleted. Table 3 also shows the maximum increase in z direction displacement to be .803 cm more than the undamaged case occurring when joint 7 is deleted in model 2. Damage criteria imposed on the models show model 2 to be the least stiff of the three models.

The displacement results of the three truss models show a truss design to be particularly stiff even when damage conditions are imposed. The "simple" open truss of model 2 shows itself to be light and strong in the undamaged condition. Model 3 with inclusion of interior structural diagonals is more massive, and more stiff than model 2. Model 1 is obviously very dense and stiffer than either model 2 or model 3. Table 14 reveals the stiffness of the undamaged three models. The lower the fundamantal frequencies the closer the model approximates a stiff bar.

The goal of retaining structural integrity after imposition of a massive damage criterion is conceptually assured by the incorporation of complete substructures. The "simple" open truss exhibits the response of a geometrical instability when a joint is deleted. The weight optimizing program does not find supporting structure to transfer the loads that were carried by the missing members of the deleted joint. With the substructure models there is additional structural support for transfer of the load that the missing members carried. The interior diagonals carry bigger loads and redistribute the load path to the remaining structure. The distribution of loads into the interior diagonals raises the confidence of stability of the structure. The structural integrity can be assured in the design stage.

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12 D. A. Reisdorfer, Tail Boom Vulnerability Reduction Test Program, Report No. 699-099-004, August 1975, Bell Helicopter Company, Fort Worth, Texas 76101.

Application of the flight loads to damage simulated models results in margins of safety that indicate no failure of individual elements. Our assumption of an inherently strong truss structure simulated by model 1 is borne out by Tables 7, 8, and 9 which show not a single margin of safety (M.S.) under 1.0 for model 1 and very few M.S. under 10.0. Since models 2 and 3 are similar except that model 3 is substructured, a direct comparison is made. Note in Tables 10, 11, and 12 the substructured model 3 consistently has the interior diagonals taking on tensile and compressive loads. This shows that the interior diagonals are working. Tables 10, 11, and 12 also indicate how the interior diagonals are redistributing the load path and how much of the load they share. Though no members of model 2 or model 3 failed, Table 13 shows that model 2 has four cases where the M.S. falls under 1.0 and model 3 has 2 cases. To show bending a complete longeron diagonally opposite the damage criteria is chosen. The amount of bending is compared by a ratio of the damage displacements to the displacement of the undamaged model in Tables 6, 7, and 8. From Tables 6, 7, and 8 noted is the response of a large amount of displacement to all models where the loss of joint 5 is encountered, yet from the stress analysis of this damage criterion all the models have M.S. greater than 1.0.

Table 15 shows the maximum and minimum presented areas and orientations. The semimonocoque presents a continuous surface whereas the truss models present noncontinuous surface area. For the maximum, model 1 shows a 16% reduction, model 2 shows a 47% reduction, and model 3 shows a 33% reduction in presented area compared to the semimonocoque. Comparison of the minimum present areas shows model 1 with a 69% reduction, model 2 with a 80% reduction, and model 3 with a 75% reduction. These reductions show a clear reduction in visibility of the truss tail boom relative to the semimonocoque type tail boom.

V. CONCLUSIONS

This study presents two ideas for alternative construction of Army helicopter tail booms. The idea of truss structures for tail booms is not new but conceptualizing a high degree of redundancy for greater damage tolerance is preferable for design of combat aircraft. The idea of imbedded substructures is specifically included for increased confidence in the capability to absorb damage and yet retain structural integrity.

The truss type tail boom models of this study provide a reduction in weight over the present semimonocoque tail boom structure of the AH-1G. The truss models are reasonably stiff structures compared to the semimonocoque structure.

Analyses of the highly redundant truss models under the aerodynamic loads of flight and with imposition of a massive damage

criterion show:

- o Substantial retention of stiffness
- o Change of load path that is localized to the neighborhood of damage
- o No failure of elements due to tension or compression
- o Retention of structural integrity

The substructured truss models have more supporting structural elements to redistribute the load and consistently have margins of safety higher than the non-substructured truss model. The substructuring concept has vulnerability reduction built-in. The substructure concept assures a higher degree of confidence in the truss concept to retain structural integrity after imposition of the loss of a joint. The substructured truss models have at least a 16% reduction in presented area compared to the semimonocoque structure. The highly redundant substructured truss type tail boom is a highly survivable structure.

ACKNOWLEDGEMENT

I wish to gratefully acknowledge Dr. Donald F. Haskell for initiating the idea of a truss structure for helicopter tail booms and for his continuing confidence shown and demonstrated in my carrying on the analysis.

A note of appreciation is also extended to Dr. V. B. Venkayya and Dr. Harry S. Schaeffer for my recent instruction in use and understanding of the complex NASTRAN program.

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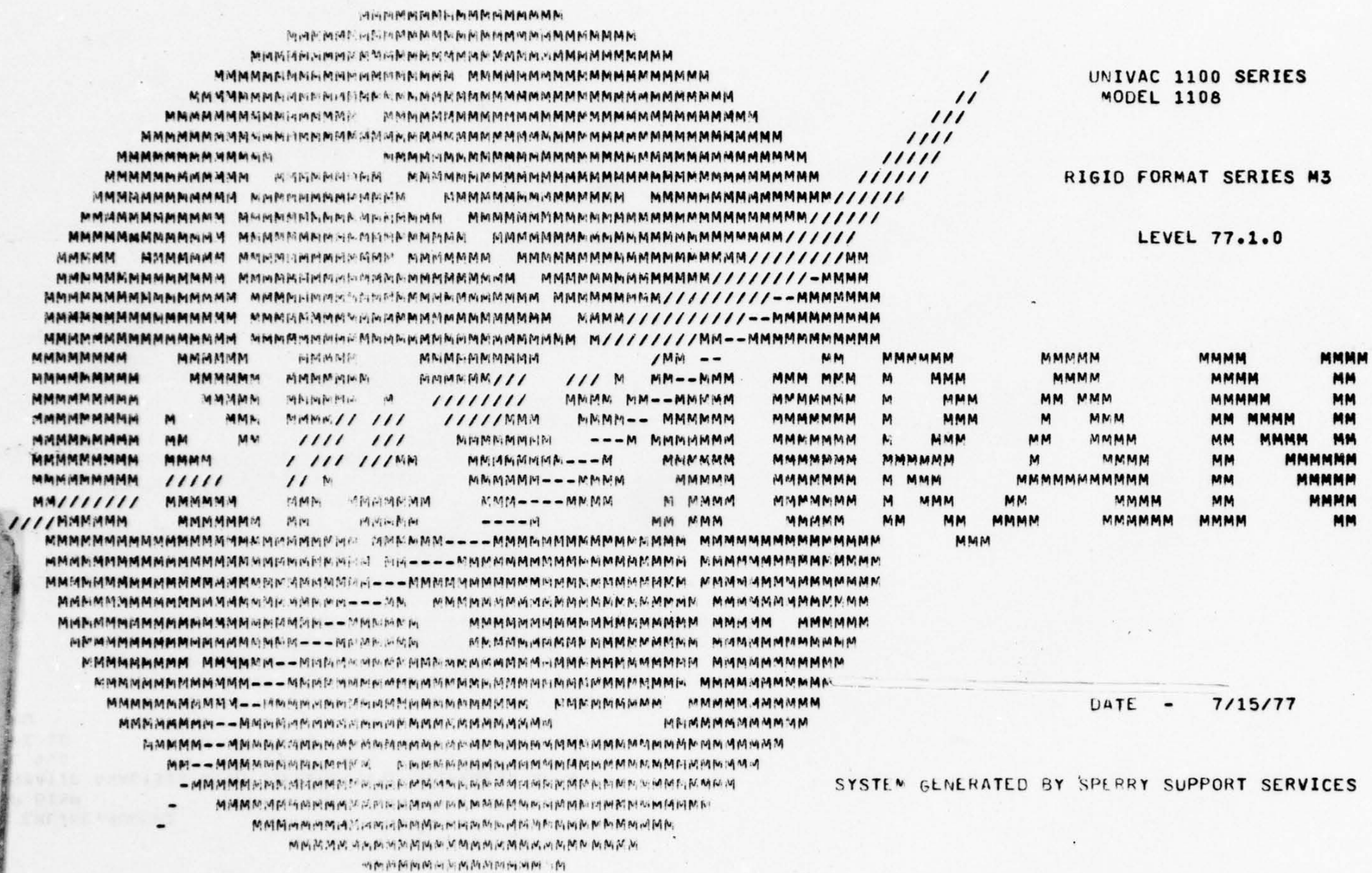
12. D. A. Reisdorfer, Tail Boom Vulnerability Reduction Test Program, Report No. 699-099-004, August 1975, Bell Helicopter Company, Fort Worth, Texas 76101.

APPENDIX A

NASTRAN MATHEMATICAL MODEL OF THE UNDAMAGED TRUSS MODEL 1 PLUS OUTPUT OF DISPLACEMENTS, STRESSES AND MARGINS OF SAFETY DUE TO FLIGHT LOADS.



UNIVAC 1100 SERIES
MODEL 1108

RIGID FORMAT SERIES M3

LEVEL 77.1.0

DATE - 7/15/77

SYSTEM GENERATED BY SPERRY SUPPORT SERVICES

N A S T R A N   E X E C U T I V E   C O N T R O L   D E C K   E C H O

```
ID ERLINE,MODEL1
APP DISP
$ STATIC ANALYSIS WITH DIFFERENTIAL STIFFNESS RF 4
SOL 4,0
TIME 10
CEND
```

```
                          C A S E    C O N T R O L    D E C K    E C H O
 CARD
 COUNT
   1       TITLE = TRUSS TAIL BOOM  MODEL1  **A 226 ELEMENT VERSION
   2       SUBTITLE = DAMAGE CRITERION = NONE
   3       OLOAD = ALL
   4       SPC = 10
   5       DISP = ALL
   6       SPCFORCES = ALL
   7       SET 5 = 1 THRU 226
   8          SUBCASE 1
   9          LABEL = LINEAR CASE
  10          LOAD = 11
  11          SUBCASE 2
  12          LABEL = INCREMENTAL STIFFNESS
  13       DSCOEFFICIENT = 200
  14          STRESS = 5
  15       $  METHOD = 15
  16       MAXLINES = 100000
  17       BEGIN BULK

*** USER INFORMATION MESSAGE 207, BULK DATA NOT SORTED,XSORT WILL RE-ORDER DECK.
```

S O R T E D   B U L K   D A T A   E C H O

CARD COUNT	. 1 ..	2 ..	3 ..	4 ..	5 .. 6 .. 7 .. 8 .. 9 .. 10 .
1-	CTUBE	1	1	1	2
2-	CTUBE	2	2	1	4
3-	CTUBE	3	3	3	4
4-	CTUBE	4	4	2	3
5-	CTUBE	5	5	1	3
6-	CTUBE	6	6	2	4
7-	CTUBE	7	7	1	5
8-	CTUBE	8	8	2	6
9-	CTUBE	9	9	3	7
10-	CTUBE	10	10	4	8
11-	CTUBE	11	11	1	6
12-	CTUBE	12	12	2	5
13-	CTUBE	13	13	1	8
14-	CTUBE	14	14	4	5
15-	CTUBE	15	15	4	7
16-	CTUBE	16	16	3	8
17-	CTUBE	17	17	2	7
18-	CTUBE	18	18	3	6
19-	CTUBE	19	19	1	7
20-	CTUBE	20	20	2	8
21-	CTUBE	21	21	3	5
22-	CTUBE	22	22	4	6
23-	CTUBE	23	23	5	6
24-	CTUBE	24	24	5	8
25-	CTUBE	25	25	7	8
26-	CTUBE	26	26	6	7
27-	CTUBE	27	27	5	7
28-	CTUBE	28	28	6	8
29-	CTUBE	29	29	5	9
30-	CTUBE	30	30	6	10
31-	CTUBE	31	31	7	11
32-	CTUBE	32	32	8	12
33-	CTUBE	33	33	5	10
34-	CTUBE	34	34	6	9
35-	CTUBE	35	35	5	12
36-	CTUBE	36	36	8	9
37-	CTUBE	37	37	8	11
38-	CTUBE	38	38	7	12
39-	CTUBE	39	39	6	11
40-	CTUBE	40	40	7	10
41-	CTUBE	41	41	5	11
42-	CTUBE	42	42	6	12
43-	CTUBE	43	43	7	9
44-	CTUBE	44	44	8	10
45-	CTUBE	45	45	9	10

TRUSS TAIL BOOM MODEL1 **A 226 ELEMENT VERSION OCTOBER 28, 1977 NASTRAN 7/15/77 PAGE 4
DAMAGE CRITERION = NONE

S O R T E D   B U L K   D A T A   E C H O

CARD COUNT	. 1 ..	2 ..	3 ..	4 ..	5 ..	6 ..	7 ..	8 ..	9 ..	10 .
46-	CTUBE	46	46	9	12					
47-	CTUBE	47	47	11	12					
48-	CTUBE	48	48	10	11					
49-	CTUBE	49	49	9	11					
50-	CTUBE	50	50	10	12					
51-	CTUBE	51	51	9	13					
52-	CTUBE	52	52	10	14					
53-	CTUBE	53	53	11	15					
54-	CTUBE	54	54	12	16					
55-	CTUBE	55	55	9	14					
56-	CTUBE	56	56	10	13					
57-	CTUBE	57	57	9	16					
58-	CTUBE	58	58	12	13					
59-	CTUBE	59	59	12	15					
60-	CTUBE	60	60	11	16					
61-	CTUBE	61	61	10	15					
62-	CTUBE	62	62	11	14					
63-	CTUBE	63	63	9	15					
64-	CTUBE	64	64	10	16					
65-	CTUBE	65	65	11	13					
66-	CTUBE	66	66	12	14					
67-	CTUBE	67	67	13	14					
68-	CTUBE	68	68	13	16					
69-	CTUBE	69	69	15	16					
70-	CTUBE	70	70	14	15					
71-	CTUBE	71	71	13	15					
72-	CTUBE	72	72	14	16					
73-	CTUBE	73	73	13	17					
74-	CTUBE	74	74	14	18					
75-	CTUBE	75	75	15	19					
76-	CTUBE	76	76	16	20					
77-	CTUBE	77	77	13	18					
78-	CTUBE	78	78	14	17					
79-	CTUBE	79	79	13	20					
80-	CTUBE	80	80	16	17					
81-	CTUBE	81	81	16	19					
82-	CTUBE	82	82	15	20					
83-	CTUBE	83	83	14	19					
84-	CTUBE	84	84	15	18					
85-	CTUBE	85	85	13	19					
86-	CTUBE	86	86	14	20					
87-	CTUBE	87	87	15	17					
88-	CTUBE	88	88	16	18					
89-	CTUBE	89	89	17	18					
90-	CTUBE	90	90	17	20					

S O R T E D   B U L K   D A T A   E C H O

CARD COUNT	. 1 ..	2 ..	3 ..	4 ..	5 .. 6 .. 7 .. 8 .. 9 .. 10 .
91-	CTUBE 91	91	19	20	
92-	CTUBE 92	92	18	19	
93-	CTUBE 93	93	17	19	
94-	CTUBE 94	94	18	20	
95-	CTUBE 95	95	17	21	
96-	CTUBE 96	96	18	22	
97-	CTUBE 97	97	19	23	
98-	CTUBE 98	98	20	24	
99-	CTUBE 99	99	17	22	
100-	CTUBE 100	100	18	21	
101-	CTUBE 101	101	17	24	
102-	CTUBE 102	102	20	21	
103-	CTUBE 103	103	20	23	
104-	CTUBE 104	104	19	24	
105-	CTUBE 105	105	18	23	
106-	CTUBE 106	106	19	22	
107-	CTUBE 107	107	17	23	
108-	CTUBE 108	108	18	24	
109-	CTUBE 109	109	19	21	
110-	CTUBE 110	110	20	22	
111-	CTUBE 111	111	21	22	
112-	CTUBE 112	112	21	24	
113-	CTUBE 113	113	23	24	
114-	CTUBE 114	114	22	23	
115-	CTUBE 115	115	21	23	
116-	CTUBE 116	116	22	24	
117-	CTUBE 117	117	21	25	
118-	CTUBE 118	118	22	26	
119-	CTUBE 119	119	23	27	
120-	CTUBE 120	120	24	28	
121-	CTUBE 121	121	21	26	
122-	CTUBE 122	122	22	25	
123-	CTUBE 123	123	21	28	
124-	CTUBE 124	124	24	25	
125-	CTUBE 125	125	24	27	
126-	CTUBE 126	126	23	28	
127-	CTUBE 127	127	22	27	
128-	CTUBE 128	128	23	26	
129-	CTUBE 129	129	21	27	
130-	CTUBE 130	130	22	28	
131-	CTUBE 131	131	23	25	
132-	CTUBE 132	132	24	26	
133-	CTUBE 133	133	25	26	
134-	CTUBE 134	134	25	28	
135-	CTUBE 135	135	27	28	

TRUSS TAIL BOOM MODEL1 **A 226 ELEMENT VERSION OCTOBER 28, 1977 NASTRAN 7/15/77 PAGE 6
DAMAGE CRITERION = NONE

SORTED BULK DATA ECHO

CARD COUNT	. 1 ..	2 ..	3 ..	4 ..	5 .. 6 .. 7 .. 8 .. 9 .. 10 .
136-	CTUBE	136	136	26	27
137-	CTUBE	137	137	25	27
138-	CTUBE	138	138	26	28
139-	CTUBE	139	139	25	29
140-	CTUBE	140	140	26	30
141-	CTUBE	141	141	27	31
142-	CTUBE	142	142	28	32
143-	CTUBE	143	143	25	30
144-	CTUBE	144	144	26	29
145-	CTUBE	145	145	25	32
146-	CTUBE	146	146	28	29
147-	CTUBE	147	147	28	31
148-	CTUBE	148	148	27	32
149-	CTUBE	149	149	26	31
150-	CTUBE	150	150	27	30
151-	CTUBE	151	151	25	31
152-	CTUBE	152	152	26	32
153-	CTUBE	153	153	27	29
154-	CTUBE	154	154	28	30
155-	CTUBE	155	155	29	30
156-	CTUBE	156	156	29	32
157-	CTUBE	157	157	31	32
158-	CTUBE	158	158	30	31
159-	CTUBE	159	159	29	31
160-	CTUBE	160	160	30	32
161-	CTUBE	161	161	29	33
162-	CTUBE	162	162	30	34
163-	CTUBE	163	163	31	35
164-	CTUBE	164	164	32	36
165-	CTUBE	165	165	29	34
166-	CTUBE	166	166	30	33
167-	CTUBE	167	167	29	36
168-	CTUBE	168	168	32	33
169-	CTUBE	169	169	32	35
170-	CTUBE	170	170	31	36
171-	CTUBE	171	171	30	35
172-	CTUBE	172	172	31	34
173-	CTUBE	173	173	29	35
174-	CTUBE	174	174	30	36
175-	CTUBE	175	175	31	33
176-	CTUBE	176	176	32	34
177-	CTUBE	177	177	33	34
178-	CTUBE	178	178	33	36
179-	CTUBE	179	179	35	36
180-	CTUBE	180	180	34	35

```
                         S O R T E D   B U L K   D A T A   E C H O
CARD
COUNT      .  1  ..  2  ..  3  ..  4  ..  5  ..  6  ..  7  ..  8  ..  9  ..  10  .
 181-      CTUBE    181      181      33       35
 182-      CTUBE    182      182      34       36
 183-      CTUBE    183      183      33       37
 184-      CTUBE    184      184      34       38
 185-      CTUBE    185      185      35       39
 186-      CTUBE    186      186      36       40
 187-      CTUBE    187      187      33       38
 188-      CTUBE    188      188      34       37
 189-      CTUBE    189      189      33       40
 190-      CTUBE    190      190      36       37
 191-      CTUBE    191      191      36       39
 192-      CTUBE    192      192      35       40
 193-      CTUBE    193      193      34       39
 194-      CTUBE    194      194      35       38
 195-      CTUBE    195      195      33       39
 196-      CTUBE    196      196      34       40
 197-      CTUBE    197      197      35       37
 198-      CTUBE    198      198      36       38
 199-      CTUBE    199      199      37       38
 200-      CTUBE    200      200      37       40
 201-      CTUBE    201      201      39       40
 202-      CTUBE    202      202      38       39
 203-      CTUBE    203      203      37       39
 204-      CTUBE    204      204      38       40
 205-      CTUBE    205      205      37       41
 206-      CTUBE    206      206      38       42
 207-      CTUBE    207      207      39       43
 208-      CTUBE    208      208      40       44
 209-      CTUBE    209      209      37       42
 210-      CTUBE    210      210      38       41
 211-      CTUBE    211      211      37       44
 212-      CTUBE    212      212      40       41
 213-      CTUBE    213      213      40       43
 214-      CTUBE    214      214      39       44
 215-      CTUBE    215      215      38       43
 216-      CTUBE    216      216      39       42
 217-      CTUBE    217      217      37       43
 218-      CTUBE    218      218      38       44
 219-      CTUBE    219      219      39       41
 220-      CTUBE    220      220      40       42
 221-      CTUBE    221      221      41       42
 222-      CTUBE    222      222      41       44
 223-      CTUBE    223      223      43       44
 224-      CTUBE    224      224      42       43
 225-      CTUBE    225      225      41       43
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TRUSS TAIL BOOM MODEL1 **A 226 ELEMENT VERSION OCTOBER 28, 1977 NASTRAN 7/15/77 PAGE 8

DAMAGE CRITERION = NONE

S O R T E D B U L K D A T A E C H O

CARD COUNT	. 1 ..	2 ..	3 ..	4 ..	5 ..	6 ..	7 ..	8 ..	9 ..	10 .
226-	CTUBE	226	226	42	44					
227-	USFACT	200	1.60422	2.40632	3.20843					
228-	FORCE	11	21	0	44.2200	.0	0.0	-1.		
229-	FORCE	11	22	0	44.2200	.0	0.0	-1.		
230-	FORCE	11	23	0	44.2200	.0	0.0	-1.		
231-	FORCE	11	24	0	44.2200	.0	0.0	-1.		
232-	FORCE	11	41	0	464.5	1.	.0	.0		
233-	FORCE	11	41	0	527.3	.0	-1.0	.0		
234-	FORCE	11	42	0	464.5	1.0	0.0	.0		
235-	FORCE	11	42	0	527.3	.0	1.	.0		
236-	FORCE	11	43	0	464.5	-1.	0.0	.0		
237-	FORCE	11	43	0	527.5	.0	1.	.0		
238-	FORCE	11	44	0	464.5	-1.	.0	.0		
239-	FORCE	11	44	0	527.3	.0	-1.	.0		
240-	GRDSET							456		
241-	GRID	1		.000	12.300	13.300				
242-	GRID	2		.000	12.100	-11.500				
243-	GRID	3		.000	-11.400	-11.500				
244-	GRID	4		.000	-11.600	13.300				
245-	GRID	5		23.700	11.300	12.300				
246-	GRID	6		23.900	11.100	-10.700				
247-	GRID	7		23.900	-10.600	-10.700				
248-	GRID	8		23.750	-10.800	12.300				
249-	GRID	9		45.950	10.400	11.300				
250-	GRID	10		45.950	10.200	-9.900				
251-	GRID	11		45.950	-9.800	-9.900				
252-	GRID	12		45.950	-10.000	11.300				
253-	GRID	13		66.400	9.500	10.500				
254-	GRID	14		66.500	9.300	-9.200				
255-	GRID	15		66.500	-9.100	-9.200				
256-	GRID	16		66.400	-9.300	10.500				
257-	GRID	17		85.400	8.800	9.700				
258-	GRID	18		85.400	8.600	-8.600				
259-	GRID	19		85.400	-8.400	-8.600				
260-	GRID	20		85.400	-8.600	9.700				
261-	GRID	21		103.000	8.000	8.900				
262-	GRID	22		103.000	7.900	-8.000				
263-	GRID	23		103.000	-7.800	-8.000				
264-	GRID	24		103.000	-8.000	8.900				
265-	GRID	25		119.300	7.400	8.300				
266-	GRID	26		119.300	7.200	-7.400				
267-	GRID	27		119.300	-7.300	-7.400				
268-	GRID	28		119.300	-7.500	8.300				
269-	GRID	29		134.400	8.700	7.600				
270-	GRID	30		134.500	6.600	-6.900				

S O R T E D   B U L K   D A T A   E C H O

```
 CARD
 COUNT      .   1  ..   2  ..   3  ..   4  ..   5  ..   6  ..   7  ..   8  ..   9  ..  10  .
  271-      GRID    31              134.500 -6.800  -6.900
  272-      GRID    32              134.400 -6.900  7.600
  273-      GRID    33              148.500 6.100   7.000
  274-      GRID    34              148.500 6.000   -6.500
  275-      GRID    35              148.500 -6.300  -6.500
  276-      GRID    36              148.500 -6.400  7.000
  277-      GRID    37              161.400 5.600   6.500
  278-      GRID    38              161.500 5.500   -6.000
  279-      GRID    39              161.500 -5.800  -6.000
  280-      GRID    40              161.400 -6.000  6.500
  281-      GRID    41              173.500 5.100   6.000
  282-      GRID    42              173.500 5.000   -5.600
  283-      GRID    43              173.500 -5.400  -5.600
  284-      GRID    44              173.500 -5.500  6.000
  285-      MAT1    1       10.5E6  3.8E6   .33     .1                                      +MAT001
  286-      +MAT001 4.36+04 3.49+04
  287-      MAT1    2       10.5E6  3.8E6   .33     .1                                      +MAT002
  288-      +MAT002 4.70+04 3.76+04
  289-      MAT1    3       10.5E6  3.8E6   .33     .1                                      +MAT003
  290-      +MAT003 4.36+04 3.49+04
  291-      MAT1    4       10.5E6  3.8E6   .33     .1                                      +MAT004
  292-      +MAT004 4.86+04 3.89+04
  293-      MAT1    5       10.5E6  3.8E6   .33     .1                                      +MAT005
  294-      +MAT005 2.28+04 1.83+04
  295-      MAT1    6       10.5E6  3.8E6   .33     .1                                      +MAT006
  296-      +MAT006 2.28+04 1.83+04
  297-      MAT1    7       10.5E6  3.8E6   .33     .1                                      +MAT007
  298-      +MAT007 4.76+04 3.81+04
  299-      MAT1    8       10.5E6  3.8E6   .33     .1                                      +MAT008
  300-      +MAT008 4.69+04 3.75+04
  301-      MAT1    9       10.5E6  3.8E6   .33     .1                                      +MAT009
  302-      +MAT009 4.69+04 3.75+04
  303-      MAT1    10      10.5E6  3.8E6   .33     .1                                      +MAT010
  304-      +MAT010 4.75+04 3.80+04
  305-      MAT1    11      10.5E6  3.8E6   .33     .1                                      +MAT011
  306-      +MAT011 2.34+04 1.87+04
  307-      MAT1    12      10.5E6  3.8E6   .33     .1                                      +MAT012
  308-      +MAT012 2.38+04 1.90+04
  309-      MAT1    13      10.5E6  3.8E6   .33     .1                                      +MAT013
  310-      +MAT013 2.44+04 1.95+04
  311-      MAT1    14      10.5E6  3.8E6   .33     .1                                      +MAT014
  312-      +MAT014 2.47+04 1.98+04
  313-      MAT1    15      10.5E6  3.8E6   .33     .1                                      +MAT015
  314-      +MAT015 2.34+04 1.87+04
  315-      MAT1    16      10.5E6  3.8E6   .33     .1                                      +MAT016
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S O R T E D   B U L K   D A T A   E C H O

```
CARD
COUNT      .  1  ..  2  ..  3  ..  4  ..  5  ..  6  ..  7  ..  8  ..  9  ..  10  .
 316-      +MAT016  2.37+04 1.90+04
 317-      MAT1    17      10.5E6  3.8E6   .33     .1                                      +MAT017
 318-      +MAT017  2.47+04 1.98+04
 319-      MAT1    18      10.5E6  3.8E6   .33     .1                                      +MAT018
 320-      +MAT018  2.49+04 1.99+04
 321-      MAT1    19      10.5E6  3.8E6   .33     .1                                      +MAT019
 322-      +MAT019  1.61+04 1.28+04
 323-      MAT1    20      10.5E6  3.8E6   .33     .1                                      +MAT020
 324-      +MAT020  1.62+04 1.30+04
 325-      MAT1    21      10.5E6  3.8E6   .33     .1                                      +MAT021
 326-      +MAT021  1.63+04 1.31+04
 327-      MAT1    22      10.5E6  3.8E6   .33     .1                                      +MAT022
 328-      +MAT022  1.61+04 1.29+04
 329-      MAT1    23      10.5E6  3.8E6   .33     .1                                      +MAT023
 330-      +MAT023  5.07+04 4.06+04
 331-      MAT1    24      10.5E6  3.8E6   .33     .1                                      +MAT024
 332-      +MAT024  5.50+04 4.40+04
 333-      MAT1    25      10.5E6  3.8E6   .33     .1                                      +MAT025
 334-      +MAT025  5.07+04 4.06+04
 335-      MAT1    26      10.5E6  3.8E6   .33     .1                                      +MAT026
 336-      +MAT026  5.70+04 4.56+04
 337-      MAT1    27      10.5E6  3.8E6   .33     .1                                      +MAT027
 338-      +MAT027  2.66+04 2.13+04
 339-      MAT1    28      10.5E6  3.8E6   .33     .1                                      +MAT028
 340-      +MAT028  2.66+04 2.13+04
 341-      MAT1    29      10.5E6  3.8E6   .33     .1                                      +MAT029
 342-      +MAT029  5.40+04 4.32+04
 343-      MAT1    30      10.5E6  3.8E6   .33     .1                                      +MAT030
 344-      +MAT030  5.51+04 4. 0+04
 345-      MAT1    31      10.5E6  3.8E6   .33     .1                                      +MAT031
 346-      +MAT031  5.51+04 4.40+04
 347-      MAT1    32      10.5E6  3.8E6   .33     .1                                      +MAT032
 348-      +MAT032  5.43+04 4.34+04
 349-      MAT1    33      10.5E6  3.8E6   .33     .1                                      +MAT033
 350-      +MAT033  2.71+04 2.17+04
 351-      MAT1    34      10.5E6  3.8E6   .33     .1                                      +MAT034
 352-      +MAT034  2.76+04 2.21+04
 353-      MAT1    35      10.5E6  3.8E6   .33     .1                                      +MAT035
 354-      +MAT035  2.83+04 2.26+04
 355-      MAT1    36      10.5E6  3.8E6   .33     .1                                      +MAT036
 356-      +MAT036  2.85+04 2.28+04
 357-      MAT1    37      10.5E6  3.8E6   .33     .1                                      +MAT037
 358-      +MAT037  2.72+04 2.18+04
 359-      MAT1    38      10.5E6  3.8E6   .33     .1                                      +MAT038
 360-      +MAT038  2.77+04 2.21+04
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                              S O R T E D   B U L K   D A T A   E C H O
CARD
COUNT        .   1  ..   2  ..   3  ..   4  ..   5  ..   6  ..   7  ..   8  ..   9  ..  10  .
  361-       MAT1    39      10.5E6  3.8E6   .33     .1                                      +MAT039
  362-       +MAT039  2.91+04 2.33+04
  363-       MAT1    40      10.5E6  3.8E6   .33     .1                                      +MAT040
  364-       +MAT040  2.92+04 2.34+04
  365-       MAT1    41      10.5E6  3.8E6   .33     .1                                      +MAT041
  366-       +MAT041  1.67+04 1.50+04
  367-       MAT1    42      10.5E6  3.8E6   .33     .1                                      +MAT042
  368-       +MAT042  1.90+04 1.52+04
  369-       MAT1    43      10.5E6  3.8E6   .33     .1                                      +MAT043
  370-       +MAT043  1.90+04 1.52+04
  371-       MAT1    44      10.5E6  3.8E6   .33     .1                                      +MAT044
  372-       +MAT044  1.88+04 1.51+04
  373-       MAT1    45      10.5E6  3.8E6   .33     .1                                      +MAT045
  374-       +MAT045  5.97+04 4.78+04
  375-       MAT1    46      10.5E6  3.8E6   .33     .1                                      +MAT046
  376-       +MAT046  6.45+04 5.16+04
  377-       MAT1    47      10.5E6  3.8E6   .33     .1                                      +MAT047
  378-       +MAT047  5.97+04 4.78+04
  379-       MAT1    48      10.5E6  3.8E6   .33     .1                                      +MAT048
  380-       +MAT048  6.71+04 5.37+04
  381-       MAT1    49      10.5E6  3.8E6   .33     .1                                      +MAT049
  382-       +MAT049  3.13+04 2.50+04
  383-       MAT1    50      10.5E6  3.8E6   .33     .1                                      +MAT050
  384-       +MAT050  3.13+04 2.50+04
  385-       MAT1    51      10.5E6  3.8E6   .33     .1                                      +MAT051
  386-       +MAT051  6.39+04 5.11+04
  387-       MAT1    52      10.5E6  3.8E6   .33     .1                                      +MAT052
  388-       +MAT052  6.34+04 5.07+04
  389-       MAT1    53      10.5E6  3.8E6   .33     .1                                      +MAT053
  390-       +MAT053  6.34+04 5.08+04
  391-       MAT1    54      10.5E6  3.8E6   .33     .1                                      +MAT054
  392-       +MAT054  6.40+04 5.12+04
  393-       MAT1    55      10.5E6  3.8E6   .33     .1                                      +MAT055
  394-       +MAT055  3.18+04 2.54+04
  395-       MAT1    56      10.5E6  3.8E6   .33     .1                                      +MAT056
  396-       +MAT056  3.22+04 2.57+04
  397-       MAT1    57      10.5E6  3.8E6   .33     .1                                      +MAT057
  398-       +MAT057  3.33+04 2.66+04
  399-       MAT1    58      10.5E6  3.8E6   .33     .1                                      +MAT058
  400-       +MAT058  3.36+04 2.69+04
  401-       MAT1    59      10.5E6  3.8E6   .33     .1                                      +MAT059
  402-       +MAT059  3.18+04 2.55+04
  403-       MAT1    60      10.5E6  3.8E6   .33     .1                                      +MAT060
  404-       +MAT060  3.22+04 2.57+04
  405-       MAT1    61      10.5E6  3.8E6   .33     .1                                      +MAT061
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DAMAGE CRITERION = NONE

S O R T E D   B U L K   D A T A   E C H O

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CARD
COUNT    .  1  ..  2  ..  3  ..  4  ..  5  ..  6  ..  7  ..  8  ..  9  ..  10  .
 406-    +MAT061  3.38+04 2.70+04
 407-    MAT1     62      10.5E6  3.8E6   .33     .1                              +MAT062
 408-    +MAT062  3.41+04 2.73+04
 409-    MAT1     63      10.5E6  3.8E6   .33     .1                              +MAT063
 410-    +MAT063  2.19+04 1.76+04
 411-    MAT1     64      10.5E6  3.8E6   .33     .1                              +MAT064
 412-    +MAT064  2.21+04 1.77+04
 413-    MAT1     65      10.5E6  3.8E6   .33     .1                              +MAT065
 414-    +MAT065  2.22+04 1.78+04
 415-    MAT1     66      10.5E6  3.8E6   .33     .1                              +MAT066
 416-    +MAT066  2.21+04 1.77+04
 417-    MAT1     67      10.5E6  3.8E6   .33     .1                              +MAT067
 418-    +MAT067  6.92+04 5.53+04
 419-    MAT1     68      10. E6  3.8E6   .33     .1                              +MAT068
 420-    +MAT068  7.59+04 6.08+04
 421-    MAT1     69      10.5E6  3.8E6   .33     .1                              +MAT069
 422-    +MAT069  6.92+04 5.53+04
 423-    MAT1     70      10.5E6  3.8E6   .33     .1                              +MAT070
 424-    +MAT070  7.93+04 6.34+04
 425-    MAT1     71      10.5E6  3.8E6   .33     .1                              +MAT071
 426-    +MAT071  3.66+04 2.93+04
 427-    MAT1     72      10.5E6  3.8E6   .33     .1                              +MAT072
 428-    +MAT072  3.66+04 2.93+04
 429-    MAT1     73      10.5E6  3.8E6   .33     .1                              +MAT073
 430-    +MAT073  7.41+04 5.93+04
 431-    MAT1     74      10.5E6  3.8E6   .33     .1                              +MAT074
 432-    +MAT074  7.50+04 6.00+04
 433-    MAT1     75      10.5E6  3.8E6   .33     .1                              +MAT075
 434-    +MAT075  7.50+04 6.00+04
 435-    MAT1     76      10.5E6  3.8E6   .33     .1                              +MAT076
 436-    +MAT076  7.41+04 5.93+04
 437-    MAT1     77      10.5E6  3.8E6   .33     .1                              +MAT077
 438-    +MAT077  3.69+04 2.95+04
 439-    MAT1     78      10.5E6  3.8E6   .33     .1                              +MAT078
 440-    +MAT078  3.76+04 3.01+04
 441-    MAT1     79      10.5E6  3.8E6   .33     .1                              +MAT079
 442-    +MAT079  3.90+04 3.12+04
 443-    MAT1     80      10.5E6  3.8E6   .33     .1                              +MAT080
 444-    +MAT080  3.90+04 3.12+04
 445-    MAT1     81      10.5E6  3.8E6   .33     .1                              +MAT081
 446-    +MAT081  3.69+04 2.95+04
 447-    MAT1     82      10.5E6  3.8E6   .33     .1                              +MAT082
 448-    +MAT082  3.76+04 3.01+04
 449-    MAT1     83      10.5E6  3.8E6   .33     .1                              +MAT083
 450-    +MAT083  4.00+04 3.20+04
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                                S O R T E D   B U L K   D A T A   E C H O
  CARD
  COUNT       .  1  ..  2  ..  3  ..  4  ..  5  ..  6  ..  7  ..  8  ..  9  ..  10  .
   451-       MAT1    84      10.5E6  3.8E6   .33     .1                              +MAT084
   452-       +MAT084  4.00+04 3.20+04
   453-       MAT1    85      10.5E6  3.8E6   .33     .1                              +MAT085
   454-       +MAT085  2.56+04 2.05+04
   455-       MAT1    86      10.5E6  3.8E6   .33     .1                              +MAT086
   456-       +MAT086  2.59+04 2.07+04
   457-       MAT1    87      10.5E6  3.8E6   .33     .1                              +MAT087
   458-       +MAT087  2.59+04 2.07+04
   459-       MAT1    88      10.5E6  3.8E6   .33     .1                              +MAT088
   460-       +MAT088  2.56+04 2.05+04
   461-       MAT1    89      10.5E6  3.8E6   .33     .1                              +MAT089
   462-       +MAT089  8.02+04 6.41+04
   463-       MAT1    90      10.5E6  3.8E6   .33     .1                              +MAT090
   464-       +MAT090  8.87+04 7.09+04
   465-       MAT1    91      10.5E6  3.8E6   .33     .1                              +MAT091
   466-       +MAT091  8.02+04 6.41+04
   467-       MAT1    92      10.5E6  3.8E6   .33     .1                              +MAT092
   468-       +MAT092  9.29+04 7.43+04
   469-       MAT1    93      10.5E6  3.8E6   .33     .1                              +MAT093
   470-       +MAT093  4.26+04 3.41+04
   471-       MAT1    94      10.5E6  3.8E6   .33     .1                              +MAT094
   472-       +MAT094  4.26+04 3.41+04
   473-       MAT1    95      10.5E6  3.8E6   .33     .1                              +MAT095
   474-       +MAT095  8.63+04 6.90+04
   475-       MAT1    96      10.5E6  3.8E6   .33     .1                              +MAT096
   476-       +MAT096  8.65+04 6.92+04
   477-       MAT1    97      10.5E6  3.8E6   .33     .1                              +MAT097
   478-       +MAT097  8.65+04 6.92+04
   479-       MAT1    98      10.5E6  3.8E6   .33     .1                              +MAT098
   480-       +MAT098  8.64+04 6.91+04
   481-       MAT1    99      10.5E6  3.8E6   .33     .1                              +MAT099
   482-       +MAT099  4.30+04 3.44+04
   483-       MAT1    100     10.5E6  3.8E6   .33     .1                              +MAT100
   484-       +MAT100  4.35+04 3.48+04
   485-       MAT1    101     10.5E6  3.8E6   .33     .1                              +MAT101
   486-       +MAT101  4.53+04 3.62+04
   487-       MAT1    102     10.5E6  3.8E6   .33     .1                              +MAT102
   488-       +MAT102  4.58+04 3.66+04
   489-       MAT1    103     10.5E6  3.8E6   .33     .1                              +MAT103
   490-       +MAT103  4.31+04 3.44+04
   491-       MAT1    104     10.5E6  3.8E6   .33     .1                              +MAT104
   492-       +MAT104  4.36+04 3.49+04
   493-       MAT1    105     10.5E6  3.8E6   .33     .1                              +MAT105
   494-       +MAT105  4.64+04 3.71+04
   495-       MAT1    106     10.5E6  3.8E6   .33     .1                              +MAT106
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                              S O R T E D   B U L K   D A T A   E C H O
CARD
COUNT      .  1  ..  2  ..  3  ..  4  ..  5  ..  6  ..  7  ..  8  ..  9  ..  10  .
  496-     +MAT106  4.66+04 3.73+04
  497-     MAT1     107     10.5E6  3.8E6   .33     .1                              +MAT107
  498-     +MAT107  2.99+04 2.39+04
  499-     MAT1     108     10.5E6  3.8E6   .33     .1                              +MAT108
  500-     +MAT108  3.01+04 2.41+04
  501-     MAT1     109     10.5E6  3.8E6   .33     .1                              +MAT109
  502-     +MAT109  3.03+04 2.43+04
  503-     MAT1     110     10.5E6  3.8E6   .33     .1                              +MAT110
  504-     +MAT110  3.00+04 2.40+04
  505-     MAT1     111     10.5E6  3.8E6   .33     .1                              +MAT111
  506-     +MAT111  9.40+04 7.52+04
  507-     MAT1     112     10.5E6  3.8E6   .33     .1                              +MAT112
  508-     +MAT112  1.05+05 8.39+04
  509-     MAT1     113     10.5E6  3.8E6   .33     .1                              +MAT113
  510-     +MAT113  9.40+04 7.52+04
  511-     MAT1     114     10.5E6  3.8E6   .33     .1                              +MAT114
  512-     +MAT114  1.09+05 8.71+04
  513-     MAT1     115     10.5E6  3.8E6   .33     .1                              +MAT115
  514-     +MAT115  5.01+04 4.01+04
  515-     MAT1     116     10.5E6  3.8E6   .33     .1                              +MAT116
  516-     +MAT116  4.99+04 3.99+04
  517-     MAT1     117     10.5E6  3.8E6   .33     .1                              +MAT117
  518-     +MAT117  1.01+05 8.06+04
  519-     MAT1     118     10.5E6  3.8E6   .33     .1                              +MAT118
  520-     +MAT118  1.01+05 8.05+04
  521-     MAT1     119     10.5E6  3.8E6   .33     .1                              +MAT119
  522-     +MAT119  1.01+05 8.06+04
  523-     MAT1     120     10.5E6  3.8E6   .33     .1                              +MAT120
  524-     +MAT120  1.01+05 8.06+04
  525-     MAT1     121     10.5E6  3.8E6   .33     .1                              +MAT121
  526-     +MAT121  5.04+04 4.03+04
  527-     MAT1     122     10.5E6  3.8E6   .33     .1                              +MAT122
  528-     +MAT122  5.05+04 4.04+04
  529-     MAT1     123     10.5E6  3.8E6   .33     .1                              +MAT123
  530-     +MAT123  5.30+04 4.24+04
  531-     MAT1     124     10.5E6  3.8E6   .33     .1                              +MAT124
  532-     +MAT124  5.34+04 4.27+04
  533-     MAT1     125     10.5E6  3.8E6   .33     .1                              +MAT125
  534-     +MAT125  5.05+04 4.04+04
  535-     MAT1     126     10.5E6  3.8E6   .33     .1                              +MAT126
  536-     +MAT126  5.05+04 4.04+04
  537-     MAT1     127     10.5E6  3.8E6   .33     .1                              +MAT127
  538-     +MAT127  5.40+04 4.32+04
  539-     MAT1     128     10.5E6  3.8E6   .33     .1                              +MAT128
  540-     +MAT128  5.47+04 4.37+04
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S O R T E D   B U L K   D A T A   E C H O

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 CARD
 COUNT      .  1  ..  2  ..  3  ..  4  ..  5  ..  6  ..  7  ..  8  ..  9  ..  10  .
  541-      MAT1     129      10.5E6  3.8E6    .33     .1                                     +MAT129
  542-      +MAT129  3.51+04 2.80+04
  543-      MAT1     130      10.5E6  3.8E6    .33     .1                                     +MAT130
  544-      +MAT130  3.49+04 2.79+04
  545-      MAT1     131      10.5E6  3.8E6    .33     .1                                     +MAT131
  546-      +MAT131  3.52+04 2.82+04
  547-      MAT1     132      10.5E6  3.8E6    .33     .1                                     +MAT132
  548-      +MAT132  3.52+04 2.82+04
  549-      MAT1     133      10.5E6  3.8E6    .33     .1                                     +MAT133
  550-      +MAT133  1.09+05 8.71+04
  551-      MAT1     134      10.5E6  3.8E6    .33     .1                                     +MAT134
  552-      +MAT134  1.21+05 9.67+04
  553-      MAT1     135      10.5E6  3.8E6    .33     .1                                     +MAT135
  554-      +MAT135  1.09+05 8.71+04
  555-      MAT1     136      10.5E6  3.8E6    .33     .1                                     +MAT136
  556-      +MAT136  1.28+05 1.02+05
  557-      MAT1     137      10.5E6  3.8E6    .33     .1                                     +MAT137
  558-      +MAT137  5.80+04 4.64+04
  559-      MAT1     138      10.5E6  3.8E6    .33     .1                                     +MAT138
  560-      +MAT138  5.80+04 4.64+04
  561-      MAT1     139      10.5E6  3.8E6    .33     .1                                     +MAT139
  562-      +MAT139  1.17+05 9.38+04
  563-      MAT1     140      10.5E6  3.8E6    .33     .1                                     +MAT140
  564-      +MAT140  1.16+05 9.27+04
  565-      MAT1     141      10.5E6  3.8E6    .33     .1                                     +MAT141
  566-      +MAT141  1.16+05 9.27+04
  567-      MAT1     142      10.5E6  3.8E6    .33     .1                                     +MAT142
  568-      +MAT142  1.17+05 9.38+04
  569-      MAT1     143      10.5E6  3.8E6    .33     .1                                     +MAT143
  570-      +MAT143  5.80+04 4.64+04
  571-      MAT1     144      10.5E6  3.8E6    .33     .1                                     +MAT144
  572-      +MAT144  5.92+04 4.74+04
  573-      MAT1     145      10.5E6  3.8E6    .33     .1                                     +MAT145
  574-      +MAT145  6.20+04 4.96+04
  575-      MAT1     146      10.5E6  3.8E6    .33     .1                                     +MAT146
  576-      +MAT146  6.24+04 4.99+04
  577-      MAT1     147      10.5E6  3.8E6    .33     .1                                     +MAT147
  578-      +MAT147  5.80+04 4.64+04
  579-      MAT1     148      10.5E6  3.8E6    .33     .1                                     +MAT148
  580-      +MAT148  5.92+04 4.74+04
  581-      MAT1     149      10.5E6  3.8E6    .33     .1                                     +MAT149
  582-      +MAT149  6.28+04 5.03+04
  583-      MAT1     150      10.5E6  3.8E6    .33     .1                                     +MAT150
  584-      +MAT150  6.33+04 5.06+04
  585-      MAT1     151      10.5E6  3.8E6    .33     .1                                     +MAT151
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DAMAGE CRITERION = NONE

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                          S O R T E D   B U L K   D A T A   E C H O
 CARD
 COUNT      .  1  ..  2  ..  3  ..  4  ..  5  ..  6  ..  7  ..  8  ..  9  ..  10  .
  586-      +MAT151  4.05+04 3.24+04
  587-      MAT1    152     10.5E6  3.8E6   .33     .1                              +MAT152
  588-      +MAT152  4.12+04 3.29+04
  589-      MAT1    153     10.5E6  3.8E6   .33     .1                              +MAT153
  590-      +MAT153  4.13+04 3.31+04
  591-      MAT1    154     10.5E6  3.8E6   .33     .1                              +MAT154
  592-      +MAT154  4.06+04 3.25+04
  593-      MAT1    155     10.5E6  3.8E6   .33     .1                              +MAT155
  594-      +MAT155  1.28+05 1.02+05
  595-      MAT1    156     10.5E6  3.8E6   .33     .1                              +MAT156
  596-      +MAT156  1.45+05 1.16+05
  597-      MAT1    157     10.5E6  3.8E6   .33     .1                              +MAT157
  598-      +MAT157  1.28+05 1.02+05
  599-      MAT1    158     10.5E6  3.8E6   .33     .1                              +MAT158
  600-      +MAT158  1.49+05 1.20+05
  601-      MAT1    159     10.5E6  3.8E6   .33     .1                              +MAT159
  602-      +MAT159  6.84+04 5.47+04
  603-      MAT1    160     10.5E6  3.8E6   .33     .1                              +MAT160
  604-      +MAT160  6.84+04 5.47+04
  605-      MAT1    161     10.5E6  3.8E6   .33     .1                              +MAT161
  606-      +MAT161  1.34+05 1.08+05
  607-      MAT1    162     10.5E6  3.8E6   .33     .1                              +MAT162
  608-      +MAT162  1.37+05 1.09+05
  609-      MAT1    163     10.5E6  3.8E6   .33     .1                              +MAT163
  610-      +MAT163  1.37+05 1.09+05
  611-      MAT1    164     10.5E6  3.8E6   .33     .1                              +MAT164
  612-      +MAT164  1.35+05 1.08+05
  613-      MAT1    165     10.5E6  3.8E6   .33     .1                              +MAT165
  614-      +MAT165  6.74+04 5.40+04
  615-      MAT1    166     10.5E6  3.8E6   .33     .1                              +MAT166
  616-      +MAT166  6.90+04 5.52+04
  617-      MAT1    167     10.5E6  3.8E6   .33     .1                              +MAT167
  618-      +MAT167  7.24+04 5.79+04
  619-      MAT1    168     10.5E6  3.8E6   .33     .1                              +MAT168
  620-      +MAT168  7.29+04 5.83+04
  621-      MAT1    169     10.5E6  3.8E6   .33     .1                              +MAT169
  622-      +MAT169  6.74+04 5.40+04
  623-      MAT1    170     10.5E6  3.8E6   .33     .1                              +MAT170
  624-      +MAT170  6.90+04 5.52+04
  625-      MAT1    171     10.5E6  3.8E6   .33     .1                              +MAT171
  626-      +MAT171  7.40+04 5.92+04
  627-      MAT1    172     10.5E6  3.8E6   .33     .1                              +MAT172
  628-      +MAT172  7.46+04 5.97+04
  629-      MAT1    173     10.5E6  3.8E6   .33     .1                              +MAT173
  630-      +MAT173  4.74+04 3.79+04
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S O R T E D   B U L K   D A T A   E C H O

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 CARD
 COUNT    .   1  ..   2  ..   3  ..   4  ..   5  ..   6  ..   7  ..   8  ..   9  ..  10  .
  631-    MAT1    174     10.5E6  3.8E6   .33     .1                                      +MAT174
  632-    +MAT174  4.81+04 3.85+04
  633-    MAT1    175     10.5E6  3.8E6   .33     .1                                      +MAT175
  634-    +MAT175  4.83+04 3.87+04
  635-    MAT1    176     10.5E6  3.8E6   .33     .1                                      +MAT176
  636-    +MAT176  4.76+04 3.81+04
  637-    MAT1    177     10.5E6  3.8E6   .33     .1                                      +MAT177
  638-    +MAT177  1.47+05 1.18+05
  639-    MAT1    178     10.5E6  3.8E6   .33     .1                                      +MAT178
  640-    +MAT178  1.72+05 1.37+05
  641-    MAT1    179     10.5E6  3.8E6   .33     .1                                      +MAT179
  642-    +MAT179  1.47+05 1.18+05
  643-    MAT1    180     10.5E6  3.8E6   .33     .1                                      +MAT180
  644-    +MAT180  1.77+05 1.42+05
  645-    MAT1    181     10.5E6  3.8E6   .33     .1                                      +MAT181
  646-    +MAT181  7.99+04 6.39+04
  647-    MAT1    182     10.5E6  3.8E6   .33     .1                                      +MAT182
  648-    +MAT182  7.99+04 6.39+04
  649-    MAT1    183     10.5E6  3.8E6   .33     .1                                      +MAT183
  650-    +MAT183  1.61+05 1.29+05
  651-    MAT1    184     10.5E6  3.8E6   .33     .1                                      +MAT184
  652-    +MAT184  1.58+05 1.27+05
  653-    MAT1    185     10.5E6  3.8E6   .33     .1                                      +MAT185
  654-    +MAT185  1.58+05 1.27+05
  655-    MAT1    186     10.5E6  3.8E6   .33     .1                                      +MAT186
  656-    +MAT186  1.61+05 1.29+05
  657-    MAT1    187     10.5E6  3.8E6   .33     .1                                      +MAT187
  658-    +MAT187  7.94+04 6.35+04
  659-    MAT1    188     10.5E6  3.8E6   .33     .1                                      +MAT188
  660-    +MAT188  8.00+04 6.40+04
  661-    MAT1    189     10.5E6  3.8E6   .33     .1                                      +MAT189
  662-    +MAT189  8.58+04 6.86+04
  663-    MAT1    190     10.5E6  3.8E6   .33     .1                                      +MAT190
  664-    +MAT190  8.64+04 6.91+04
  665-    MAT1    191     10.5E6  3.8E6   .33     .1                                      +MAT191
  666-    +MAT191  7.94+04 6.35+04
  667-    MAT1    192     10.5E6  3.8E6   .33     .1                                      +MAT192
  668-    +MAT192  5.60+04 4.48+04
  669-    MAT1    193     10.5E6  3.8E6   .33     .1                                      +MAT193
  670-    +MAT193  8.71+04 6.96+04
  671-    MAT1    194     10.5E6  3.8E6   .33     .1                                      +MAT194
  672-    +MAT194  8.71+04 6.96+04
  673-    MAT1    195     10.5E6  3.8E6   .33     .1                                      +MAT195
  674-    +MAT195  5.60+04 4.48+04
  675-    MAT1    196     10.5E6  3.8E6   .33     .1                                      +MAT196
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S O R T E D   B U L K   D A T A   E C H O

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 CARD
 COUNT        .  1  ..  2  ..  3  ..  4  ..  5  ..  6  ..  7  ..  8  ..  9  ..  10  .
  676-        +MAT196  5.60+04 4.48+04
  677-        MAT1    197     10.5E6  3.8E6   .33     .1                              +MAT197
  678-        +MAT197  5.63+04 4.50+04
  679-        MAT1    198     10.5E6  3.8E6   .33     .1                              +MAT198
  680-        +MAT198  5.60+04 4.48+04
  681-        MAT1    199     10.5E6  3.8E6   .33     .1                              +MAT199
  682-        +MAT199  1.72+05 1.37+05
  683-        MAT1    200     10.5E6  3.8E6   .33     .1                              +MAT200
  684-        +MAT200  1.99+05 1.60+05
  685-        MAT1    201     10.5E6  3.8E6   .33     .1                              +MAT201
  686-        +MAT201  1.72+05 1.37+05
  687-        MAT1    202     10.5E6  3.8E6   .33     .1                              +MAT202
  688-        +MAT202  2.10+05 1.68+05
  689-        MAT1    203     10.5E6  3.8E6   .33     .1                              +MAT203
  690-        +MAT203  9.38+04 7.50+04
  691-        MAT1    204     10.5E6  3.8E6   .33     .1                              +MAT204
  692-        +MAT204  9.30+04 7.44+04
  693-        MAT1    205     10.5E6  3.8E6   .33     .1                              +MAT205
  694-        +MAT205  1.83+05 1.46+05
  695-        MAT1    206     10.5E6  3.8E6   .33     .1                              +MAT206
  696-        +MAT206  1.86+05 1.49+05
  697-        MAT1    207     10.5E6  3.8E6   .33     .1                              +MAT207
  698-        +MAT207  1.86+05 1.49+05
  699-        MAT1    208     10.5E6  3.8E6   .33     .1                              +MAT208
  700-        +MAT208  1.83+05 1.46+05
  701-        MAT1    209     10.5E6  3.8E6   .33     .1                              +MAT209
  702-        +MAT209  9.16+04 7.33+04
  703-        MAT1    210     10.5E6  3.8E6   .33     .1                              +MAT210
  704-        +MAT210  9.31+04 7.45+04
  705-        MAT1    211     10.5E6  3.8E6   .33     .1                              +MAT211
  706-        +MAT211  9.94+04 7.95+04
  707-        MAT1    212     10.5E6  3.8E6   .33     .1                              +MAT212
  708-        +MAT212  9.94+04 7.95+04
  709-        MAT1    213     10.5E6  3.8E6   .33     .1                              +MAT213
  710-        +MAT213  9.16+04 7.33+04
  711-        MAT1    214     10.5E6  3.8E6   .33     .1                              +MAT214
  712-        +MAT214  9.32+04 7.46+04
  713-        MAT1    215     10.5E6  3.8E6   .33     .1                              +MAT215
  714-        +MAT215  1.02+05 8.16+04
  715-        MAT1    216     10.5E6  3.8E6   .33     .1                              +MAT216
  716-        +MAT216  1.03+05 8.23+04
  717-        MAT1    217     10.5E6  3.8E6   .33     .1                              +MAT217
  718-        +MAT217  6.49+04 5.19+04
  719-        MAT1    218     10.5E6  3.8E6   .33     .1                              +MAT218
  720-        +MAT218  6.57+04 5.25+04
```

```
                        S O R T E D   B U L K   D A T A   E C H O
 CARD
 COUNT        .  1  ..  2  ..  3  ..  4  ..  5  ..  6  ..  7  ..  8  ..  9  ..  10  .
  721-        MAT1    219     10.5E6  3.8E6   .33     .1                              +MAT219
  722-        +MAT219  6.60+04 5.28+04
  723-        MAT1    220     10.5E6  3.8E6   .33     .1                              +MAT220
  724-        +MAT220  6.49+04 5.19+04
  725-        MAT1    221     10.5E6  3.8E6   .33     .1                              +MAT221
  726-        +MAT221  1.99+05 1.60+05
  727-        MAT1    222     10.5E6  3.8E6   .33     .1                              +MAT222
  728-        +MAT222  2.39+05 1.91+05
  729-        MAT1    223     10.5E6  3.8E6   .33     .1                              +MAT223
  730-        +MAT223  1.99+05 1.60+05
  731-        MAT1    224     10.5E6  3.8E6   .33     .1                              +MAT224
  732-        +MAT224  2.48+05 1.99+05
  733-        MAT1    225     10.5E6  3.8E6   .33     .1                              +MAT225
  734-        +MAT225  1.10+05 8.77+04
  735-        MAT1    226     10.5E6  3.8E6   .33     .1                              +MAT226
  736-        +MAT226  1.10+05 8.77+04
  737-        PARAM   GRDPNT  0
  738-        PTUBE   1       1       1.5     .0625
  739-        PTUBE   2       2       1.5     .0625
  740-        PTUBE   3       3       1.5     .0625
  741-        PTUBE   4       4       1.5     .0625
  742-        PTUBE   5       5       1.5     .0625
  743-        PTUBE   6       6       1.5     .0625
  744-        PTUBE   7       7       1.5     .0625
  745-        PTUBE   8       8       1.5     .0625
  746-        PTUBE   9       9       1.5     .0625
  747-        PTUBE   10      10      1.5     .0625
  748-        PTUBE   11      11      1.5     .0625
  749-        PTUBE   12      12      1.5     .0625
  750-        PTUBE   13      13      1.5     .0625
  751-        PTUBE   14      14      1.5     .0625
  752-        PTUBE   15      15      1.5     .0625
  753-        PTUBE   16      16      1.5     .0625
  754-        PTUBE   17      17      1.5     .0625
  755-        PTUBE   18      18      1.5     .0625
  756-        PTUBE   19      19      1.5     .0625
  757-        PTUBE   20      20      1.5     .0625
  758-        PTUBE   21      21      1.5     .0625
  759-        PTUBE   22      22      1.5     .0625
  760-        PTUBE   23      23      1.5     .0625
  761-        PTUBE   24      24      1.5     .0625
  762-        PTUBE   25      25      1.5     .0625
  763-        PTUBE   26      26      1.5     .0625
  764-        PTUBE   27      27      1.5     .0625
  765-        PTUBE   28      28      1.5     .0625
```

S O R T E D   B U L K   D A T A   E C H O

CARD COUNT	. 1 ..	2 ..	3 ..	4 ..	5 ..	6 ..	7 ..	8 ..	9 ..	10 .
766-	PTUBE	29	29	1.5	.0625					
767-	PTUBE	30	30	1.5	.0625					
768-	PTUBE	31	31	1.5	.0625					
769-	PTUBE	32	32	1.5	.0625					
770-	PTUBE	33	33	1.5	.0625					
771-	PTUBE	34	34	1.5	.0625					
772-	PTUBE	35	35	1.5	.0625					
773-	PTUBE	36	36	1.5	.0625					
774-	PTUBE	37	37	1.5	.0625					
775-	PTUBE	38	38	1.5	.0625					
776-	PTUBE	39	39	1.5	.0625					
777-	PTUBE	40	40	1.5	.0625					
778-	PTUBE	41	41	1.5	.0625					
779-	PTUBE	42	42	1.5	.0625					
780-	PTUBE	43	43	1.5	.0625					
781-	PTUBE	44	44	1.5	.0625					
782-	PTUBE	45	45	1.5	.0625					
783-	PTUBE	46	46	1.5	.0625					
784-	PTUBE	47	47	1.5	.0625					
785-	PTUBE	48	48	1.5	.0625					
786-	PTUBE	49	49	1.5	.0625					
787-	PTUBE	50	50	1.5	.0625					
788-	PTUBE	51	51	1.5	.0625					
789-	PTUBE	52	52	1.5	.0625					
790-	PTUBE	53	53	1.5	.0625					
791-	PTUBE	54	54	1.5	.0625					
792-	PTUBE	55	55	1.5	.0625					
793-	PTUBE	56	56	1.5	.0625					
794-	PTUBE	57	57	1.5	.0625					
795-	PTUBE	58	58	1.5	.0625					
796-	PTUBE	59	59	1.5	.0625					
797-	PTUBE	60	60	1.5	.0625					
798-	PTUBE	61	61	1.5	.0625					
799-	PTUBE	62	62	1.5	.0625					
800-	PTUBE	63	63	1.5	.0625					
801-	PTUBE	64	64	1.5	.0625					
802-	PTUBE	65	65	1.5	.0625					
803-	PTUBE	66	66	1.5	.0625					
804-	PTUBE	67	67	1.5	.0625					
805-	PTUBE	68	68	1.5	.0625					
806-	PTUBE	69	69	1.5	.0625					
807-	PTUBE	70	70	1.5	.0625					
808-	PTUBE	71	71	1.5	.0625					
809-	PTUBE	72	72	1.5	.0625					
810-	PTUBE	73	73	1.5	.0625					

DAMAGE CRITERION = NONE

S O R T E D B U L K D A T A E C H O

CARD COUNT	. 1 ..	2 ..	3 ..	4 ..	5 ..	6 ..	7 ..	8 ..	9 ..	10 .
811-	PTUBE	74	74	1.5	.0625					
812-	PTUBE	75	75	1.5	.0625					
813-	PTUBE	76	76	1.5	.0625					
814-	PTUBE	77	77	1.5	.0625					
815-	PTUBE	78	78	1.5	.0625					
816-	PTUBE	79	79	1.5	.0625					
817-	PTUBE	80	80	1.5	.0625					
818-	PTUBE	81	81	1.5	.0625					
819-	PTUBE	82	82	1.5	.0625					
820-	PTUBE	83	83	1.5	.0625					
821-	PTUBE	84	84	1.5	.0625					
822-	PTUBE	85	85	1.5	.0625					
823-	PTUBE	86	86	1.5	.0625					
824-	PTUBE	87	87	1.5	.0625					
825-	PTUBE	88	88	1.5	.0625					
826-	PTUBE	89	89	1.5	.0625					
827-	PTUBE	90	90	1.5	.0625					
828-	PTUBE	91	91	1.5	.0625					
829-	PTUBE	92	92	1.5	.0625					
830-	PTUBE	93	93	1.5	.0625					
831-	PTUBE	94	94	1.5	.0625					
832-	PTUBE	95	95	1.5	.0625					
833-	PTUBE	96	96	1.5	.0625					
834-	PTUBE	97	97	1.5	.0625					
835-	PTUBE	98	98	1.5	.0625					
836-	PTUBE	99	99	1.5	.0625					
837-	PTUBE	100	100	1.5	.0625					
838-	PTUBE	101	101	1.5	.0625					
839-	PTUBE	102	102	1.5	.0625					
840-	PTUBE	103	103	1.5	.0625					
841-	PTUBE	104	104	1.5	.0625					
842-	PTUBE	105	105	1.5	.0625					
843-	PTUBE	106	106	1.5	.0625					
844-	PTUBE	107	107	1.5	.0625					
845-	PTUBE	108	108	1.5	.0625					
846-	PTUBE	109	109	1.5	.0625					
847-	PTUBE	110	110	1.5	.0625					
848-	PTUBE	111	111	1.5	.0625					
849-	PTUBE	112	112	1.5	.0625					
850-	PTUBE	113	113	1.5	.0625					
851-	PTUBE	114	114	1.5	.0625					
852-	PTUBE	115	115	1.5	.0625					
853-	PTUBE	116	116	1.5	.0625					
854-	PTUBE	117	117	1.5	.0625					
855-	PTUBE	118	118	1.5	.0625					

DAMAGE CRITERION = NONE

S O R T E D   B U L K   D A T A   E C H O

CARD COUNT	. 1 ..	2 ..	3 ..	4 ..	5 .. 6 .. 7 .. 8 .. 9 .. 10 .
856-	PTUBE	119	119	1.5	.0625
857-	PTUBE	120	120	1.5	.0625
858-	PTUBE	121	121	1.5	.0625
859-	PTUBE	122	122	1.5	.0625
860-	PTUBE	123	123	1.5	.0625
861-	PTUBE	124	124	1.5	.0625
862-	PTUBE	125	125	1.5	.0625
863-	PTUBE	126	126	1.5	.0625
864-	PTUBE	127	127	1.5	.0625
865-	PTUBE	128	128	1.5	.0625
866-	PTUBE	129	129	1.5	.0625
867-	PTUBE	130	130	1.5	.0625
868-	PTUBE	131	131	1.5	.0625
869-	PTUBE	132	132	1.5	.0625
870-	PTUBE	133	133	1.5	.0625
871-	PTUBE	134	134	1.5	.0625
872-	PTUBE	135	135	1.5	.0625
873-	PTUBE	136	136	1.5	.0625
874-	PTUBE	137	137	1.5	.0625
875-	PTUBE	138	138	1.5	.0625
876-	PTUBE	139	139	1.5	.0625
877-	PTUBE	140	140	1.5	.0625
878-	PTUBE	141	141	1.5	.0625
879-	PTUBE	142	142	1.5	.0625
880-	PTUBE	143	143	1.5	.0625
881-	PTUBE	144	144	1.5	.0625
882-	PTUBE	145	145	1.5	.0625
883-	PTUBE	146	146	1.5	.0625
884-	PTUBE	147	147	1.5	.0625
885-	PTUBE	148	148	1.5	.0625
886-	PTUBE	149	149	1.5	.0625
887-	PTUBE	150	150	1.5	.0625
888-	PTUBE	151	151	1.5	.0625
889-	PTUBE	152	152	1.5	.0625
890-	PTUBE	153	153	1.5	.0625
891-	PTUBE	154	154	1.5	.0625
892-	PTUBE	155	155	1.5	.0625
893-	PTUBE	156	156	1.5	.0625
894-	PTUBE	157	157	1.5	.0625
895-	PTUBE	158	158	1.5	.0625
896-	PTUBE	159	159	1.5	.0625
897-	PTUBE	160	160	1.5	.0625
898-	PTUBE	161	161	1.5	.0625
899-	PTUBE	162	162	1.5	.0625
900-	PTUBE	163	163	1.5	.0625

S O R T E D B U L K D A T A E C H O

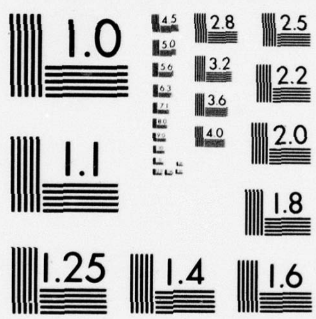
CARD COUNT	. 1 ..	2 ..	3 ..	4 ..	5 ..	6 ..	7 ..	8 ..	9 ..	10 .
901-	PTUBE	164	164	1.5	.0625					
902-	PTUBE	165	165	1.5	.0625					
903-	PTUBE	166	166	1.5	.0625					
904-	PTUBE	167	167	1.5	.0625					
905-	PTUBE	168	168	1.5	.0625					
906-	PTUBE	169	169	1.5	.0625					
907-	PTUBE	170	170	1.5	.0625					
908-	PTUBE	171	171	1.5	.0625					
909-	PTUBE	172	172	1.5	.0625					
910-	PTUBE	173	173	1.5	.0625					
911-	PTUBE	174	174	1.5	.0625					
912-	PTUBE	175	175	1.5	.0625					
913-	PTUBE	176	176	1.5	.0625					
914-	PTUBE	177	177	1.5	.0625					
915-	PTUBE	178	178	1.5	.0625					
916-	PTUBE	179	179	1.5	.0625					
917-	PTUBE	180	180	1.5	.0625					
918-	PTUBE	181	181	1.5	.0625					
919-	PTUBE	182	182	1.5	.0625					
920-	PTUBE	183	183	1.5	.0625					
921-	PTUBE	184	184	1.5	.0625					
922-	PTUBE	185	185	1.5	.0625					
923-	PTUBE	186	186	1.5	.0625					
924-	PTUBE	187	187	1.5	.0625					
925-	PTUBE	188	188	1.5	.0625					
926-	PTUBE	189	189	1.5	.0625					
927-	PTUBE	190	190	1.5	.0625					
928-	PTUBE	191	191	1.5	.0625					
929-	PTUBE	192	192	1.5	.0625					
930-	PTUBE	193	193	1.5	.0625					
931-	PTUBE	194	194	1.5	.0625					
932-	PTUBE	195	195	1.5	.0625					
933-	PTUBE	196	196	1.5	.0625					
934-	PTUBE	197	197	1.5	.0625					
935-	PTUBE	198	198	1.5	.0625					
936-	PTUBE	199	199	1.5	.0625					
937-	PTUBE	200	200	1.5	.0625					
938-	PTUBE	201	201	1.5	.0625					
939-	PTUBE	202	202	1.5	.0625					
940-	PTUBE	203	203	1.5	.0625					
941-	PTUBE	204	204	1.5	.0625					
942-	PTUBE	205	205	1.5	.0625					
943-	PTUBE	206	206	1.5	.0625					
944-	PTUBE	207	207	1.5	.0625					
945-	PTUBE	208	208	1.5	.0625					

```
DAMAGE CRITERION = NONE


                            S O R T E D   B U L K   D A T A   E C H O
 CARD
 COUNT        .  1  ..  2  ..  3  ..  4  ..  5  ..  6  ..  7  ..  8  ..  9  ..  10  .
  946-        PTUBE   209      209     1.5     .0625
  947-        PTUBE   210      210     1.5     .0625
  948-        PTUBE   211      211     1.5     .0625
  949-        PTUBE   212      212     1.5     .0625
  950-        PTUBE   213      213     1.5     .0625
  951-        PTUBE   214      214     1.5     .0625
  952-        PTUBE   215      215     1.5     .0625
  953-        PTUBE   216      216     1.5     .0625
  954-        PTUBE   217      217     1.5     .0625
  955-        PTUBE   218      218     1.5     .0625
  956-        PTUBE   219      219     1.5     .0625
  957-        PTUBE   220      220     1.5     .0625
  958-        PTUBE   221      221     1.5     .0625
  959-        PTUBE   222      222     1.5     .0625
  960-        PTUBE   223      223     1.5     .0625
  961-        PTUBE   224      224     1.5     .0625
  962-        PTUBE   225      225     1.5     .0625
  963-        PTUBE   226      226     1.5     .0625
  964-        SPC     10       1       123456          2       123456
  965-        SPC     10       3       123456          4       123456
              ENDDATA

 *  19.6 CPU-S   71.0 COR-S    119 ELP-S.     XGP1

        **NO ERRORS FOUND - EXECUTE NASTRAN PROGRAM**

 *  23.1 CPU-S   75.3 COR-S    131 ELP-S.     SEM1  END

 *  23.1 CPU-S   75.3 COR-S    131 ELP-S.     ----  LINK   END   ---
```

AD-A064 181 ARMY ARMAMENT RESEARCH AND DEVELOPMENT COMMAND ABERD--ETC F/G 1/3
HIGHLY SURVIVABLE TRUSS TYPE TAIL BOOM.(U)
NOV 78 T F ERLINE
UNCLASSIFIED ARBRL-TR-02123 SBIE-AD-E430 172 NL

2 OF 2
AD
A064181

END
DATE
FILMED
4-79
DDC



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

S O R T E D   B U L K   D A T A   E C H O

```
 CARD
 COUNT        .   1  ..   2  ..   3  ..   4  ..   5  ..   6  ..   7  ..   8  ..   9  ..  10  .
  946-        PTUBE   209     209     1.5     .0625
  947-        PTUBE   210     210     1.5     .0625
  948-        PTUBE   211     211     1.5     .0625
  949-        PTUBE   212     212     1.5     .0625
  950-        PTUBE   213     213     1.5     .0625
  951-        PTUBE   214     214     1.5     .0625
  952-        PTUBE   215     215     1.5     .0625
  953-        PTUBE   216     216     1.5     .0625
  954-        PTUBE   217     217     1.5     .0625
  955-        PTUBE   218     218     1.5     .0625
  956-        PTUBE   219     219     1.5     .0625
  957-        PTUBE   220     220     1.5     .0625
  958-        PTUBE   221     221     1.5     .0625
  959-        PTUBE   222     222     1.5     .0625
  960-        PTUBE   223     223     1.5     .0625
  961-        PTUBE   224     224     1.5     .0625
  962-        PTUBE   225     225     1.5     .0625
  963-        PTUBE   226     226     1.5     .0625
  964-        SPC     10      1       123456          2       123456
  965-        SPC     10      3       123456          4       123456
              ENDDATA

 *  19.6 CPU-S  71.0 COR-S   119 ELP-S.      XGPI

          **NO ERRORS FOUND - EXECUTE NASTRAN PROGRAM**

 *  23.1 CPU-S  75.3 COR-S   131 ELP-S.      SEM1   END

 *  23.1 CPU-S  75.3 COR-S   131 ELP-S.      ----   LINK    END   ---
```

DAMAGE CRITERION = NONE

LINEAR CASE 30 % LOADING SUBCASE 1

D I S P L A C E M E N T   V E C T O R

POINT ID.	TYPE	X (IN)	Y (IN)	Z (IN)	R1	R2	R3
1*	G	.0	.0	.0	.0	.0	.0
2	G	.0	.0	.0	.0	.0	.0
3	G	.0	.0	.0	.0	.0	.0
4	G	.0	.0	.0	.0	.0	.0
5	G	3.317836-03	-4.525320-03	2.740695-04	.0	.0	.0
6	G	-7.179699-04	2.263182-03	8.276372-04	.0	.0	.0
7	G	-3.250243-03	1.422724-03	-5.456768-03	.0	.0	.0
8	G	5.966247-04	-3.688462-03	-4.836820-03	.0	.0	.0
9	G	6.047826-03	-1.120983-02	-2.942591-03	.0	.0	.0
10	G	-8.974057-04	9.010426-04	-2.458876-03	.0	.0	.0
11	G	-5.959460-03	3.353342-04	-1.394383-02	.0	.0	.0
12	G	6.588768-04	-1.062861-02	-1.344618-02	.0	.0	.0
13	G	8.030114-03	-2.034682-02	-8.673496-03	.0	.0	.0
14	G	-5.977568-04	-3.228083-03	-8.271170-03	.0	.0	.0
15	G	-8.014410-03	-3.596386-03	-2.457499-02	.0	.0	.0
16	G	2.322428-04	-1.998783-02	-2.408844-02	.0	.0	.0
17	G	9.446027-03	-3.179971-02	-1.560709-02	.0	.0	.0
18	G	1.477403-04	-9.917407-03	-1.523586-02	.0	.0	.0
19	G	-9.468949-03	-1.008557-02	-3.600965-02	.0	.0	.0
20	G	-6.510956-04	-3.161392-02	-3.562558-02	.0	.0	.0
21	G	1.018451-02	-4.528521-02	-2.304737-02	.0	.0	.0
22	G	1.261433-03	-1.915144-02	-2.259622-02	.0	.0	.0
23	G	-1.039838-02	-1.912108-02	-4.751317-02	.0	.0	.0
24	G	-1.976220-03	-4.531758-02	-4.721712-02	.0	.0	.0
25	G	1.084307-02	-6.111844-02	-2.947164-02	.0	.0	.0
26	G	2.441486-03	-3.066077-02	-2.924202-02	.0	.0	.0
27	G	-1.109875-02	-3.065947-02	-5.797527-02	.0	.0	.0
28	G	-3.362920-03	-6.112394-02	-5.775036-02	.0	.0	.0
29	G	1.124946-02	-7.849591-02	-3.567908-02	.0	.0	.0
30	G	3.547208-03	-4.429195-02	-3.534126-02	.0	.0	.0
31	G	-1.177890-02	-4.428613-02	-6.770101-02	.0	.0	.0
32	G	-4.606679-03	-7.850019-02	-6.726075-02	.0	.0	.0
33	G	1.171436-02	-9.796644-02	-4.140473-02	.0	.0	.0
34	G	4.472547-03	-5.969817-02	-4.105748-02	.0	.0	.0
35	G	-1.240374-02	-5.969571-02	-7.659027-02	.0	.0	.0
36	G	-5.828729-03	-9.796801-02	-7.623815-02	.0	.0	.0
37	G	1.230858-02	-1.190330-01	-4.650517-02	.0	.0	.0
38	G	5.372231-03	-7.750216-02	-4.624579-02	.0	.0	.0
39	G	-1.278492-02	-7.749596-02	-8.468287-02	.0	.0	.0
40	G	-7.096980-03	-1.190386-01	-8.465548-02	.0	.0	.0
41	G	1.287949-02	-1.425276-01	-5.188111-02	.0	.0	.0
42	G	5.943539-03	-9.621248-02	-5.194198-02	.0	.0	.0
43	G	-1.310663-02	-9.621593-02	-9.160534-02	.0	.0	.0
44	G	-8.188774-03	-1.425316-01	-9.167417-02	.0	.0	.0

DAMAGE CRITERION = NONE

INCREMENTAL STIFFNESS 75 % LOADING SUBCASE 2

D I S P L A C E M E N T   V E C T O R

POINT ID.	TYPE	X (IN)	Y (IN)	Z (IN)	R1	R2	R3
1	G	.0	.0	.0	.0	.0	.0
2	G	.0	.0	.0	.0	.0	.0
3	G	.0	.0	.0	.0	.0	.0
4	G	.0	.0	.0	.0	.0	.0
5	G	8.161912-03	-1.098737-02	5.579749-04	.0	.0	.0
6	G	-1.331652-03	5.506288-03	1.917068-03	.0	.0	.0
7	G	-7.990130-03	3.424577-03	-1.329790-02	.0	.0	.0
8	G	1.547047-03	-8.898459-03	-1.179971-02	.0	.0	.0
9	G	1.490923-02	-2.720790-02	-7.559873-03	.0	.0	.0
10	G	-2.355201-03	2.166273-03	-6.371371-03	.0	.0	.0
11	G	-1.467079-02	7.538492-04	-3.417505-02	.0	.0	.0
12	G	1.803218-03	-2.573578-02	-3.296987-02	.0	.0	.0
13	G	1.963718-02	-4.940244-02	-2.198809-02	.0	.0	.0
14	G	-1.719038-03	-7.911682-03	-2.100304-02	.0	.0	.0
15	G	-1.975753-02	-8.845319-03	-6.046708-02	.0	.0	.0
16	G	8.759458-04	-4.846624-02	-5.928702-02	.0	.0	.0
17	G	2.337809-02	-7.722830-02	-3.953872-02	.0	.0	.0
18	G	-7.862373-06	-2.421004-02	-3.863130-02	.0	.0	.0
19	G	-2.337501-02	-2.465797-02	-8.890931-02	.0	.0	.0
20	G	-1.154399-03	-7.670873-02	-8.798461-02	.0	.0	.0
21	G	2.524820-02	-1.099700-01	-5.851043-02	.0	.0	.0
22	G	2.586679-03	-4.666657-02	-5.742018-02	.0	.0	.0
23	G	-2.569833-02	-4.663386-02	-1.177156-01	.0	.0	.0
24	G	-4.249045-03	-1.099780-01	-1.170125-01	.0	.0	.0
25	G	2.691757-02	-1.483379-01	-7.521807-02	.0	.0	.0
26	G	5.345885-03	-7.457530-02	-7.466317-02	.0	.0	.0
27	G	-2.744954-02	-7.460943-02	-1.441914-01	.0	.0	.0
28	G	-7.489396-03	-1.482817-01	-1.436619-01	.0	.0	.0
29	G	2.795246-02	-1.904010-01	-9.155695-02	.0	.0	.0
30	G	7.934486-03	-1.075763-01	-9.074915-02	.0	.0	.0
31	G	-2.914447-02	-1.075954-01	-1.690522-01	.0	.0	.0
32	G	-1.040860-02	-1.903437-01	-1.679927-01	.0	.0	.0
33	G	2.912243-02	-2.374892-01	-1.068737-01	.0	.0	.0
34	G	1.009445-02	-1.446328-01	-1.060361-01	.0	.0	.0
35	G	-3.070055-02	-1.448545-01	-1.920171-01	.0	.0	.0
36	G	-1.328380-02	-2.374274-01	-1.911783-01	.0	.0	.0
37	G	3.060175-02	-2.884089-01	-1.207733-01	.0	.0	.0
38	G	1.222505-02	-1.878536-01	-1.201455-01	.0	.0	.0
39	G	-3.164108-02	-1.878572-01	-2.131544-01	.0	.0	.0
40	G	-1.627245-02	-2.883468-01	-2.131045-01	.0	.0	.0
41	G	3.198195-02	-3.451012-01	-1.353408-01	.0	.0	.0
42	G	1.354832-02	-2.330576-01	-1.356319-01	.0	.0	.0
43	G	-3.248165-02	-2.330799-01	-2.316478-01	.0	.0	.0
44	G	-1.887229-02	-3.451223-01	-2.316757-01	.0	.0	.0

DAMAGE CRITERION = NONE

INCREMENTAL STIFFNESS 50 % LOADING SUBCASE 2

DISPLACEMENT VECTOR

POINT ID.	TYPE	X (IN)	Y (IN)	Z (IN)	R1	R2	R3
1	6	.0	.0	.0	.0	.0	.0
2	6	.0	.0	.0	.0	.0	.0
3	6	.0	.0	.0	.0	.0	.0
4	6	.0	.0	.0	.0	.0	.0
5	6	5.401103-03	-7.302572-03	3.946496-04	.0	.0	.0
6	6	-1.198328-03	3.657666-03	1.294459-03	.0	.0	.0
7	6	-5.288627-03	2.283098-03	-8.827812-03	.0	.0	.0
8	6	1.006949-03	-5.926726-03	-7.830610-03	.0	.0	.0
9	6	9.659174-03	-1.808461-02	-4.933166-03	.0	.0	.0
10	6	-1.527266-03	1.446033-03	-4.146489-03	.0	.0	.0
11	6	-9.706006-03	5.158317-04	-2.264438-02	.0	.0	.0
12	6	1.154376-03	-1.711960-02	-2.184279-02	.0	.0	.0
13	6	1.310690-02	-3.283236-02	-1.440982-02	.0	.0	.0
14	6	-1.084519-03	-5.239063-03	-1.375706-02	.0	.0	.0
15	6	-1.306519-02	-5.850910-03	-4.001381-02	.0	.0	.0
16	6	5.143350-04	-3.222438-02	-3.922930-02	.0	.0	.0
17	6	1.543848-02	-5.132059-02	-2.591715-02	.0	.0	.0
18	6	7.447933-05	-1.605720-02	-2.531549-02	.0	.0	.0
19	6	-1.545040-02	-1.634617-02	-5.876828-02	.0	.0	.0
20	6	-8.602542-04	-5.099040-02	-5.815204-02	.0	.0	.0
21	6	1.666514-02	-7.308003-02	-3.832684-02	.0	.0	.0
22	6	1.823047-03	-3.097260-02	-3.760114-02	.0	.0	.0
23	6	-1.697971-02	-3.094178-02	-7.772112-02	.0	.0	.0
24	6	-2.944162-03	-7.310096-02	-7.725040-02	.0	.0	.0
25	6	1.775880-02	-9.859499-02	-4.918683-02	.0	.0	.0
26	6	3.680367-03	-4.952760-02	-4.881749-02	.0	.0	.0
27	6	-1.813233-02	-4.954203-02	-9.508106-02	.0	.0	.0
28	6	-5.125788-03	-9.857303-02	-9.472551-02	.0	.0	.0
29	6	1.843620-02	-1.265778-01	-5.976685-02	.0	.0	.0
30	6	5.422151-03	-7.148031-02	-5.922723-02	.0	.0	.0
31	6	-1.924920-02	-7.148564-02	-1.113292-01	.0	.0	.0
32	6	-7.088307-03	-1.265547-01	-1.106230-01	.0	.0	.0
33	6	1.920476-02	-1.579131-01	-6.963489-02	.0	.0	.0
34	6	6.877025-03	-9.627356-02	-6.907696-02	.0	.0	.0
35	6	-2.027487-02	-9.628187-02	-1.262873-01	.0	.0	.0
36	6	-9.019688-03	-1.578865-01	-1.257263-01	.0	.0	.0
37	6	2.018002-02	-1.918048-01	-7.853878-02	.0	.0	.0
38	6	8.305113-03	-1.249110-01	-7.812101-02	.0	.0	.0
39	6	-2.089675-02	-1.249092-01	-1.400071-01	.0	.0	.0
40	6	-1.102624-02	-1.917804-01	-1.399702-01	.0	.0	.0
41	6	2.109892-02	-2.295606-01	-8.788695-02	.0	.0	.0
42	6	9.198828-03	-1.549945-01	-8.804872-02	.0	.0	.0
43	6	-2.143307-02	-1.550151-01	-1.519258-01	.0	.0	.0
44	6	-1.276571-02	-2.295722-01	-1.519764-01	.0	.0	.0

TRUSS TAIL BOOM MODEL1 **A 226 ELEMENT VERSION OCTOBER 28, 1977 NASTRAN 7/15/77 PAGE 40

DAMAGE CRITERION = NONE

INCREMENTAL STIFFNESS 100% LOADING SUBCASE 2

D I S P L A C E M E N T V E C T O R

POINT ID.	TYPE	X (IN)	Y (IN)	Z (IN)	R1	R2	R3
1	G	.0	.0	.0	.0	.0	.0
2	G	.0	.0	.0	.0	.0	.0
3	G	.0	.0	.0	.0	.0	.0
4	G	.0	.0	.0	.0	.0	.0
5	G	1.096420-02	-1.469579-02	6.984184-04	.0	.0	.0
6	G	-2.487121-03	7.367751-03	2.523562-03	.0	.0	.0
7	G	-1.073104-02	4.565494-03	-1.780627-02	.0	.0	.0
8	G	2.110931-03	-1.187691-02	-1.580512-02	.0	.0	.0
9	G	2.004217-02	-3.638981-02	-1.029409-02	.0	.0	.0
10	G	-3.224803-03	2.881837-03	-8.697676-03	.0	.0	.0
11	G	-1.971255-02	9.756505-04	-4.584691-02	.0	.0	.0
12	G	2.496644-03	-3.439400-02	-4.423597-02	.0	.0	.0
13	G	2.668495-02	-6.608486-02	-2.981716-02	.0	.0	.0
14	G	-2.413424-03	-1.062667-02	-2.849552-02	.0	.0	.0
15	G	-2.655981-02	-1.189280-02	-8.122218-02	.0	.0	.0
16	G	1.305582-03	-6.480412-02	-7.964410-02	.0	.0	.0
17	G	3.146380-02	-1.033173-01	-5.360582-02	.0	.0	.0
18	G	-1.679463-04	-3.245814-02	-5.238903-02	.0	.0	.0
19	G	-3.143681-02	-3.307480-02	-1.195619-01	.0	.0	.0
20	G	-1.359779-03	-1.025920-01	-1.183283-01	.0	.0	.0
21	G	3.400341-02	-1.471174-01	-7.937973-02	.0	.0	.0
22	G	3.253697-03	-6.251793-02	-7.792355-02	.0	.0	.0
23	G	-3.457429-02	-6.249245-02	-1.584763-01	.0	.0	.0
24	G	-5.444535-03	-1.470968-01	-1.575426-01	.0	.0	.0
25	G	3.626689-02	-1.984105-01	-1.022158-01	.0	.0	.0
26	G	6.697176-03	-9.983833-02	-1.014746-01	.0	.0	.0
27	G	-3.693942-02	-9.990059-02	-1.943624-01	.0	.0	.0
28	G	-9.722358-03	-1.983045-01	-1.936614-01	.0	.0	.0
29	G	3.767535-02	-2.546222-01	-1.246287-01	.0	.0	.0
30	G	1.031651-02	-1.439430-01	-1.235538-01	.0	.0	.0
31	G	-3.922579-02	-1.439834-01	-2.281658-01	.0	.0	.0
32	G	-1.358183-02	-2.545156-01	-2.267529-01	.0	.0	.0
33	G	3.925623-02	-3.175297-01	-1.457402-01	.0	.0	.0
34	G	1.316653-02	-1.937147-01	[illegible].446224-01	.0	.0	.0
35	G	-4.132415-02	-1.937561-01	[illegible].594938-01	.0	.0	.0
36	G	-1.738820-02	-3.174180-01	-2.583791-01	.0	.0	.0
37	G	4.125649-02	-3.855419-01	-1.650010-01	.0	.0	.0
38	G	1.599165-02	-2.511697-01	-1.641622-01	.0	.0	.0
39	G	-4.256842-02	-2.511627-01	-2.884251-01	.0	.0	.0
40	G	-2.134271-02	-3.854251-01	-2.883660-01	.0	.0	.0
41	G	4.369257-02	-4.612186-01	-1.651539-01	.0	.0	.0
42	G	1.773295-02	-3.115010-01	-1.056070-01	.0	.0	.0
43	G	-4.370124-02	-3.115723-01	-3.139087-01	.0	.0	.0
44	G	-2.479655-02	-4.612526-01	-3.138896-01	.0	.0	.0

DAMAGE CRITERION = NONE

INCREMENTAL STIFFNESS 50 % LOADING SUBCASE 2

S T R E S S E S I N R O D E L E M E N T S (C T U B E) (LBS/SQ.IN.)

ELEMENT ID.	AXIAL STRESS	SAFETY MARGIN	TORSIONAL STRESS	SAFETY MARGIN	ELEMENT ID.	AXIAL STRESS	SAFETY MARGIN	TORSIONAL STRESS	SAFETY MARGIN
1	.0		.0		2	.0		.0	
3	.0		.0		4	.0		.0	
5	.0		.0		6	.0		.0	
7	2.513079+03	1.8+01	.0		8	-5.730164+02	6.4+01	.0	
9	-2.414269+03	1.5+01	.0		10	5.012258+02	9.4+01	.0	
11	-5.859145+02	3.1+01	.0		12	1.332449+03	1.7+01	.0	
13	1.611815+03	1.4+01	.0		14	-3.826537+02	5.1+01	.0	
15	8.024666+02	2.8+01	.0		16	-1.541390+03	1.1+01	.0	
17	-1.789568+03	1.0+01	.0		18	5.326748+02	4.6+01	.0	
19	2.084545+02	7.6+01	.0		20	-1.696044+02	7.6+01	.0	
21	-1.812566+02	7.1+01	.0		22	1.472966+02	1.1+02	.0	
23	-4.804175+02	8.4+01	.0		24	-6.584026+02	6.6+01	.0	
25	4.690359+02	1.1+02	.0		26	6.651136+02	8.5+01	.0	
27	5.463867-01	4.9+04	.0		28	-3.218697+00	6.6+03	.0	
29	2.413797+03	2.1+01	.0		30	-2.070356+02	2.1+02	.0	
31	-2.366522+03	1.8+01	.0		32	1.769000+02	3.1+02	.0	
33	-6.684247+02	3.1+01	.0		34	1.319998+03	2.0+01	.0	
35	1.512953+03	1.8+01	.0		36	-7.138011+02	3.1+01	.0	
37	1.037365+03	2.5+01	.0		38	-1.686630+03	1.2+01	.0	
39	-1.603797+03	1.4+01	.0		40	7.910505+02	3.6+01	.0	
41	7.594144+01	2.5+02	.0		42	-1.390335+02	1.1+02	.0	
43	-5.975171+01	2.5+02	.0		44	1.235029+02	1.5+02	.0	
45	-4.808416+02	9.8+01	.0		46	-4.966935+02	1.0+02	.0	
47	4.793735+02	1.2+02	.0		48	4.883556+02	1.4+02	.0	
49	-3.075134+00	8.1+03	.0		50	-1.661591+00	1.5+04	.0	
51	2.184587+03	2.8+01	.0		52	2.079078+02	3.0+02	.0	
53	-2.124558+03	2.3+01	.0		54	-2.442134+02	2.1+02	.0	
55	-7.234236+02	3.4+01	.0		56	1.432937+03	2.1+01	.0	
57	1.494955+03	2.1+01	.0		58	-8.918735+02	2.9+01	.0	
59	1.125940+03	2.7+01	.0		60	-1.832963+03	1.3+01	.0	
61	-1.602568+03	1.6+01	.0		62	9.795283+02	3.4+01	.0	
63	8.157941+01	2.7+02	.0		64	-1.501217+02	1.2+02	.0	
65	-7.891406+01	2.2+02	.0		66	1.514687+02	1.4+02	.0	
67	-5.355593+02	1.0+02	.0		68	-3.395662+02	1.8+02	.0	
69	5.240415+02	1.3+02	.0		70	3.491517+02	2.3+02	.0	
71	-1.054932+00	2.8+04	.0		72	-5.177612-01	5.7+04	.0	
73	1.925554+03	3.7+01	.0		74	6.610580+02	1.1+02	.0	
75	-1.867392+03	3.1+01	.0		76	-6.992236+02	8.4+01	.0	
77	-7.868762+02	3.6+01	.0		78	1.550012+03	2.3+01	.0	
79	1.496589+03	2.5+01	.0		80	-1.108003+03	2.7+01	.0	
81	1.216079+03	2.9+01	.0		82	-1.979158+03	1.4+01	.0	
83	-1.595301+03	1.9+01	.0		84	1.197457+03	3.2+01	.0	
85	9.551575+01	2.7+02	.0		86	-1.611028+02	1.3+02	.0	
87	-8.889575+01	2.3+02	.0		88	1.533651+02	1.7+02	.0	
89	-5.662751+02	1.1+02	.0		90	-1.992517+02	3.5+02	.0	

TRUSS TAIL BOOM MODEL **A 226 ELEMENT VERSION OCTOBER 28, 1977 NASTRAN 7/15/77 PAGE 45
DAMAGE CRITERION = NONE

INCREMENTAL STIFFNESS 50 % LOADING SUBCASE 2

S T R E S S E S I N R O D E L E M E N T S (C T U B E) (LBS/SQ.IN.)

ELEMENT ID.	AXIAL STRESS	SAFETY MARGIN	TORSIONAL STRESS	SAFETY MARGIN	ELEMENT ID.	AXIAL STRESS	SAFETY MARGIN	TORSIONAL STRESS	SAFETY MARGIN
91	5.707593+02	1.4+02	.0		92	1.784789+02	5.2+02	.0	
93	-6.397949+00	5.3+03	.0		94	-9.631348-01	3.5+04	.0	
95	1.651580+03	5.1+01	.0		96	1.144083+03	7.5+01	.0	
97	-1.590996+03	4.2+01	.0		98	-1.171246+03	5.8+01	.0	
99	-8.606906+02	3.9+01	.0		100	1.678153+03	2.5+01	.0	
101	1.479375+03	3.0+01	.0		102	-1.327839+03	2.7+01	.0	
103	1.325091+03	3.2+01	.0		104	-2.147634+03	1.5+01	.0	
105	-1.586388+03	2.2+01	.0		106	1.427854+03	3.2+01	.0	
107	9.443364+01	3.2+02	.0		108	-1.773944+02	1.3+02	.0	
109	-8.870654+01	2.7+02	.0		110	1.614818+02	1.8+02	.0	
111	-6.056536+02	1.2+02	.0		112	1.373535+01	7.6+03	.0	
113	6.023530+02	1.6+02	.0		114	-2.060889+01	4.2+03	.0	
115	-4.101563-01	9.8+04	.0		116	-4.515991+00	8.8+03	.0	
117	1.562786+03	6.4+01	.0		118	1.439171+03	6.9+01	.0	
119	-1.518171+03	5.2+01	.0		120	-1.490877+03	5.3+01	.0	
121	-1.174221+03	3.3+01	.0		122	2.068227+03	2.3+01	.0	
123	1.530281+03	3.4+01	.0		124	-1.502105+03	2.7+01	.0	
125	1.175889+03	4.2+01	.0		126	-2.059461+03	1.9+01	.0	
127	-1.637135+03	2.5+01	.0		128	1.610426+03	3.3+01	.0	
129	-3.067358+01	9.1+02	.0		130	-4.572046+01	6.1+02	.0	
131	4.156123+01	6.5+02	.0		132	3.908972+01	9.0+02	.0	
133	-6.649380+02	1.3+02	.0		134	-1.547363+01	6.2+03	.0	
135	6.554028+02	1.7+02	.0		136	1.045361+01	1.2+04	.0	
137	-1.223633+01	3.8+03	.0		138	4.810547+00	1.2+04	.0	
139	1.706793+03	6.6+01	.0		140	1.561146+03	7.3+01	.0	
141	-1.635831+03	5.6+01	.0		142	-1.619312+03	5.7+01	.0	
143	-1.294241+03	3.5+01	.0		144	2.249318+03	2.5+01	.0	
145	1.640231+03	3.7+01	.0		146	-1.619726+03	3.0+01	.0	
147	1.286183+03	4.4+01	.0		148	-2.251420+03	2.0+01	.0	
149	-1.778448+03	2.7+01	.0		150	1.756503+03	3.5+01	.0	
151	-4.603125+01	7.0+02	.0		152	-5.809705+01	5.7+02	.0	
153	5.495215+01	7.5+02	.0		154	4.388464+01	9.2+02	.0	
155	-7.308437+02	1.4+02	.0		156	-1.782715+01	6.5+03	.0	
157	7.255484+02	1.8+02	.0		158	4.179199+00	3.6+04	.0	
159	3.785156+00	1.3+04	.0		160	-1.290527+01	4.2+03	.0	
161	1.871228+03	7.1+01	.0		162	1.672579+03	8.1+01	.0	
163	-1.750305+03	6.1+01	.0		164	-1.781577+03	6.0+01	.0	
165	-1.395871+03	3.8+01	.0		166	2.467049+03	2.7+01	.0	
167	1.772514+03	4.0+01	.0		168	-1.754500+03	3.2+01	.0	
169	1.400972+03	4.7+01	.0		170	-2.466527+03	2.1+01	.0	
171	-1.929952+03	3.0+01	.0		172	1.906998+03	3.8+01	.0	
173	-3.214180+01	1.2+03	.0		174	-6.097119+01	6.3+02	.0	
175	5.655127+01	6.5+02	.0		176	3.238525+01	1.5+03	.0	
177	-7.890298+02	1.5+02	.0		178	-2.232422+01	6.1+03	.0	
179	7.912764+02	1.4+02	.0		180	7.098633+00	2.5+04	.0	

DAMAGE CRITERION = NONE

INCREMENTAL STIFFNESS 50 % LOADING SUBCASE 2

S T R E S S E S I N R O D E L E M E N T S (C T U B E) (LBS/SQ.IN.)

ELEMENT ID.	AXIAL STRESS	SAFETY MARGIN	TORSIONAL STRESS	SAFETY MARGIN	ELEMENT ID.	AXIAL STRESS	SAFETY MARGIN	TORSIONAL STRESS	SAFETY MARGIN
181	1.814941+01	4.4+03	.0		182	-2.389746+01	2.7+03	.0	
183	2.137536+03	7.4+01	.0		184	1.756927+03	8.9+01	.0	
185	-1.812439+03	6.9+01	.0		186	-2.034296+03	6.2+01	.0	
187	-1.588130+03	3.9+01	.0		188	2.716524+03	2.8+01	.0	
189	1.844613+03	4.6+01	.0		190	-1.823012+03	3.7+01	.0	
191	1.583730+03	4.9+01	.0		192	-2.729661+03	1.5+01	.0	
193	-1.995350+03	3.4+01	.0		194	1.967314+03	4.3+01	.0	
195	1.691662+01	3.3+03	.0		196	-1.419800+02	3.1+02	.0	
197	1.293525+02	4.3+02	.0		198	-2.707178+01	1.7+03	.0	
199	-8.801348+02	1.5+02	.0		200	-2.213672+01	7.2+03	.0	
201	8.631416+02	2.0+02	.0		202	-1.625000+00	1.0+05	.0	
203	6.003320+01	1.6+03	.0		204	-7.946729+01	9.4+02	.0	
205	2.477996+03	7.3+01	.0		206	1.584727+03	1.2+02	.0	
207	-1.691239+03	8.7+01	.0		208	-2.425800+03	5.9+01	.0	
209	-1.428569+03	5.0+01	.0		210	2.849251+03	3.2+01	.0	
211	2.229136+03	4.4+01	.0		212	-2.205611+03	3.5+01	.0	
213	1.461186+03	6.2+01	.0		214	-2.823113+03	2.5+01	.0	
215	-2.325636+03	3.4+01	.0		216	2.295219+03	4.4+01	.0	
217	-5.131152+02	1.0+02	.0		218	3.121401+02	2.1+02	.0	
219	-2.919414+02	1.8+02	.0		220	5.358247+02	1.2+02	.0	
221	-4.353975+02	3.7+02	.0		222	1.140039+01	2.1+04	.0	
223	5.359141+02	3.7+02	.0		224	2.076758+01	1.2+04	.0	
225	-1.710365+03	5.0+01	.0		226	1.780122+03	6.1+01	.0	

TRUSS TAIL BOOM MODEL1 **A 226 ELEMENT VERSION OCTOBER 28, 1977 NASTRAN 7/15/77 PAGE 48

DAMAGE CRITERION = NONE

INCREMENTAL STIFFNESS 75 % LOADING SUBCASE 2

S T R E S S E S I N R O D E L E M E N T S (C T U B E) (LBS/SQ.IN.)

ELEMENT ID.	AXIAL STRESS	SAFETY MARGIN	TORSIONAL STRESS	SAFETY MARGIN	ELEMENT ID.	AXIAL STRESS	SAFETY MARGIN	TORSIONAL STRESS	SAFETY MARGIN
91	8.563584+02	9.3+01	.0		92	2.766646+02	3.3+02	.0	
93	-1.211914+01	2.6+03	.0		94	-3.129639+00	1.1+04	.0	
95	2.503874+03	3.3+01	.0		96	1.693946+03	5.0+01	.0	
97	-2.413285+03	2.8+01	.0		98	-1.730121+03	3.9+01	.0	
99	-1.294235+03	2.6+01	.0		100	2.522539+03	1.6+01	.0	
101	2.231884+03	1.9+01	.0		102	-1.989594+03	1.7+01	.0	
103	1.992042+03	2.1+01	.0		104	-3.226106+03	9.8+00	.0	
105	-2.390769+03	1.5+01	.0		106	2.134958+03	2.1+01	.0	
107	1.420098+02	2.1+02	.0		108	-2.657806+02	9.0+01	.0	
109	-1.348865+02	1.8+02	.0		110	2.409902+02	1.2+02	.0	
111	-9.100669+02	8.2+01	.0		112	5.246094+00	2.0+04	.0	
113	9.024551+02	1.0+02	.0		114	-2.187427+01	4.0+03	.0	
115	-2.819824+00	1.4+04	.0		116	-8.940918+00	4.5+03	.0	
117	2.374544+03	4.2+01	.0		118	2.133775+03	4.6+01	.0	
119	-2.303374+03	3.4+01	.0		120	-2.207244+03	3.6+01	.0	
121	-1.765076+03	2.2+01	.0		122	3.107073+03	1.5+01	.0	
123	2.308205+03	2.2+01	.0		124	-2.249587+03	1.8+01	.0	
125	1.768982+03	2.8+01	.0		126	-3.094152+03	1.2+01	.0	
127	-2.469725+03	1.6+01	.0		128	2.410490+03	2.2+01	.0	
129	-4.649414+01	6.0+02	.0		130	-6.978052+01	4.0+02	.0	
131	6.114600+01	5.7+02	.0		132	5.817676+01	6.0+02	.0	
133	-9.993750+02	8.6+01	.0		134	-3.957324+01	2.4+03	.0	
135	9.816182+02	1.1+02	.0		136	2.472119+01	5.2+03	.0	
137	-2.102051+01	2.2+03	.0		138	4.619629+00	1.3+04	.0	
139	2.591447+03	4.4+01	.0		140	2.316407+03	4.9+01	.0	
141	-2.479947+03	3.6+01	.0		142	-2.398841+03	3.8+01	.0	
143	-1.930448+03	2.3+01	.0		144	3.379048+03	1.7+01	.0	
145	2.473710+03	2.4+01	.0		146	-2.426299+03	2.0+01	.0	
147	1.935244+03	2.9+01	.0		148	-3.382723+03	1.3+01	.0	
149	-2.682609+03	1.6+01	.0		150	2.629799+03	2.3+01	.0	
151	-6.953961+01	4.6+02	.0		152	-8.861548+01	3.7+02	.0	
153	8.093730+01	5.1+02	.0		154	6.537671+01	6.2+02	.0	
155	-1.098455+03	9.2+01	.0		156	-4.418750+01	2.6+03	.0	
157	1.086801+03	1.2+02	.0		158	1.495410+01	1.0+04	.0	
159	2.578125+00	2.7+04	.0		160	-2.239502+01	2.4+03	.0	
161	2.838501+03	4.6+01	.0		162	2.483339+03	5.4+01	.0	
163	-2.651632+03	4.0+01	.0		164	-2.641626+03	4.0+01	.0	
165	-2.097825+03	2.5+01	.0		166	3.705879+03	1.8+01	.0	
167	2.672932+03	2.6+01	.0		168	-2.628769+03	2.1+01	.0	
169	2.104574+03	3.1+01	.0		170	-3.706188+03	1.4+01	.0	
171	-2.910718+03	1.9+01	.0		172	2.855780+03	2.5+01	.0	
173	-4.859865+01	7.5+02	.0		174	-9.324805+01	4.1+02	.0	
175	8.292440+01	[illegible]	.0		176	4.832275+01	9.8+02	.0	
177	-1.135227+03	4.9+01	.0		178	-5.191406+01	2.6+03	.0	
179	1.185654+03	1.2+02	.0		180	1.855664+01	9.5+03	.0	

DAMAGE CRITERION = NONE

INCREMENTAL STIFFNESS 75 % LOADING SUBCASE 2

S T R E S S E S I N R O D E L E M E N T S (C T U B E) (LBS/SQ.IN.)

ELEMENT ID.	AXIAL STRESS	SAFETY MARGIN	TORSIONAL STRESS	SAFETY MARGIN	ELEMENT ID.	AXIAL STRESS	SAFETY MARGIN	TORSIONAL STRESS	SAFETY MARGIN
1	.0		.0		2	.0		.0	
3	.0		.0		4	.0		.0	
5	.0		.0		6	.0		.0	
7	3.797478+03	1.2+01	.0		8	-8.752129+02	4.2+01	.0	
9	-3.647329+03	9.3+00	.0		10	7.688577+02	6.1+01	.0	
11	-8.811505+02	2.0+01	.0		12	2.004681+03	1.1+01	.0	
13	2.424397+03	9.0+00	.0		14	-5.672701+02	3.4+01	.0	
15	1.203531+03	1.5+01	.0		16	-2.315942+03	7.2+00	.0	
17	-2.697972+03	6.3+00	.0		18	7.952054+02	3.0+01	.0	
19	3.125762+02	5.1+01	.0		20	-2.557945+02	5.0+01	.0	
21	-2.727904+02	4.7+01	.0		22	2.223576+02	7.1+01	.0	
23	-7.254938+02	5.5+01	.0		24	-9.995728+02	4.3+01	.0	
25	7.043995+02	7.1+01	.0		26	1.007280+03	5.6+01	.0	
27	-1.736420+00	1.2+04	.0		28	-5.503540+00	3.9+03	.0	
29	3.652574+03	1.4+01	.0		30	-3.266145+02	1.3+02	.0	
31	-3.578677+03	1.1+01	.0		32	2.842719+02	1.9+02	.0	
33	-1.004693+03	2.1+01	.0		34	1.985396+03	1.3+01	.0	
35	2.279516+03	1.1+01	.0		36	-1.065935+03	2.0+01	.0	
37	1.557409+03	1.6+01	.0		38	-2.535160+03	7.7+00	.0	
39	-2.417395+03	8.6+00	.0		40	1.183270+03	2.4+01	.0	
41	1.121420+02	1.7+02	.0		42	-2.088716+02	7.2+01	.0	
43	-9.013721+01	1.7+02	.0		44	1.856157+02	1.0+02	.0	
45	-7.258307+02	6.5+01	.0		46	-7.577074+02	6.7+01	.0	
47	7.206125+02	8.2+01	.0		48	7.415224+02	8.9+01	.0	
49	-7.169678+00	3.5+03	.0		50	-3.266418+00	7.7+03	.0	
51	3.310092+03	1.8+01	.0		52	2.949982+02	2.1+02	.0	
53	-3.216269+03	1.5+01	.0		54	-3.460582+02	1.5+02	.0	
55	-1.087029+03	2.2+01	.0		56	2.155097+03	1.4+01	.0	
57	2.253595+03	1.4+01	.0		58	-1.333581+03	1.9+01	.0	
59	1.690990+03	1.8+01	.0		60	-2.754711+03	8.3+00	.0	
61	-2.415609+03	1.0+01	.0		62	1.464707+03	2.2+01	.0	
63	1.212932+02	1.8+02	.0		64	-2.253537+02	7.8+01	.0	
65	-1.193195+02	1.5+02	.0		66	2.272993+02	9.6+01	.0	
67	-8.077521+02	6.7+01	.0		68	-5.228784+02	1.2+02	.0	
69	7.874292+02	8.7+01	.0		70	5.327816+02	1.5+02	.0	
71	-4.089111+00	7.2+03	.0		72	-1.989929+00	1.5+04	.0	
73	2.921486+03	2.4+01	.0		74	9.727913+02	7.6+01	.0	
75	-2.829970+03	2.0+01	.0		76	-1.026086+03	5.7+01	.0	
77	-1.182678+03	2.4+01	.0		78	2.330633+03	1.5+01	.0	
79	2.257688+03	1.6+01	.0		80	-1.658812+03	1.8+01	.0	
81	1.827187+03	1.9+01	.0		82	-2.973885+03	9.1+00	.0	
83	-2.404586+03	1.2+01	.0		84	1.790767+03	2.1+01	.0	
85	1.428909+02	1.8+02	.0		86	-2.416179+02	8.5+01	.0	
87	-1.347888+02	1.5+02	.0		88	2.295203+02	1.1+02	.0	
89	-8.530154+02	7.4+01	.0		90	-3.135308+02	2.3+02	.0	

TRUSS TAIL BOOM MODEL1 **A 226 ELEMENT VERSION OCTOBER 28, 1977 NASTRAN 7/15/77 PAGE 58
DAMAGE CRITERION = NONE

INCREMENTAL STIFFNESS 100% LOADING SUBCASE 2

S T R E S S E S I N R O D E L E M E N T S (C T U B E) (LBS/SQ.IN.)

ELEMENT ID.	AXIAL STRESS	SAFETY MARGIN	TORSIONAL STRESS	SAFETY MARGIN	ELEMENT ID.	AXIAL STRESS	SAFETY MARGIN	TORSIONAL STRESS	SAFETY MARGIN
1	.0		.0		2	.0		.0	
3	.0		.0		4	.0		.0	
5	.0		.0		6	.0		.0	
7	5.101056+03	8.3+00	.0		8	-1.187582+03	3.1+01	.0	
9	-4.898210+03	6.7+00	.0		10	1.047549+03	4.4+01	.0	
11	-1.177830+03	1.5+01	.0		12	2.681167+03	7.9+00	.0	
13	3.252208+03	6.5+00	.0		14	-7.473961+02	2.5+01	.0	
15	1.604378+03	1.4+01	.0		16	-3.093311+03	5.1+00	.0	
17	-3.615645+03	4.5+00	.0		18	1.055270+03	2.3+01	.0	
19	4.166331+02	3.8+01	.0		20	-3.429081+02	3.7+01	.0	
21	-3.649494+02	3.5+01	.0		22	2.983596+02	5.3+01	.0	
23	-9.740558+02	4.1+01	.0		24	-1.348798+03	3.2+01	.0	
25	9.404948+02	5.3+01	.0		26	1.355931+03	4.1+01	.0	
27	-5.761383+00	3.7+03	.0		28	-8.237411+00	2.6+03	.0	
29	4.913271+03	1.0+01	.0		30	-4.565922+02	9.5+01	.0	
31	-4.810716+03	8.1+00	.0		32	4.039727+02	1.3+02	.0	
33	-1.342313+03	1.5+01	.0		34	2.654633+03	9.4+00	.0	
35	3.952952+03	8.3+00	.0		36	-1.414921+03	1.5+01	.0	
37	2.078325+03	1.2+01	.0		38	-3.387421+03	5.5+00	.0	
39	-3.233969+03	6.2+00	.0		40	1.573366+03	1.6+01	.0	
41	1.471295+02	1.3+02	.0		42	-2.789336+02	5.3+01	.0	
43	-1.208662+02	1.2+02	.0		44	2.479878+02	7.5+01	.0	
45	-9.740884+02	4.6+01	.0		46	-1.027256+03	4.9+01	.0	
47	9.630522+02	6.1+01	.0		48	1.000748+03	6.6+01	.0	
49	-1.301123+01	1.9+03	.0		50	-5.386261+00	4.6+03	.0	
51	4.458414+03	1.3+01	.0		52	3.711416+02	1.7+02	.0	
53	-4.323220+03	1.1+01	.0		54	-4.346582+02	1.2+02	.0	
55	-1.451903+03	1.6+01	.0		56	2.881327+03	1.0+01	.0	
57	3.019864+03	1.0+01	.0		58	-1.772530+03	1.4+01	.0	
59	2.257431+03	1.3+01	.0		60	-3.680252+03	6.0+00	.0	
61	-3.236694+03	7.5+00	.0		62	1.946927+03	1.7+01	.0	
63	1.602610+02	1.4+02	.0		64	-3.007039+02	5.8+01	.0	
65	-1.603645+02	1.1+02	.0		66	3.032131+02	7.2+01	.0	
67	-1.083105+03	5.0+01	.0		68	-7.153066+02	8.4+01	.0	
69	1.051694+03	6.5+01	.0		70	7.225172+02	1.1+02	.0	
71	-8.835670+00	3.5+03	.0		72	-4.268860+00	6.9+03	.0	
73	3.940192+03	1.8+01	.0		74	1.272265+03	5.8+01	.0	
75	-3.512399+03	1.5+01	.0		76	-1.338010+03	4.3+01	.0	
77	-1.580109+03	1.5+01	.0		78	3.115316+03	1.1+01	.0	
79	3.027567+03	1.2+01	.0		80	-2.207601+03	1.3+01	.0	
81	2.440461+03	1.4+01	.0		82	-3.972358+03	6.6+00	.0	
83	-3.221572+03	[illegible]	.0		84	2.380595+03	1.6+01	.0	
85	1.899875+02	1.3+02	.0		86	-3.221087+02	6.3+01	.0	
87	-1.816555+02	1.1+02	.0		88	3.053400+02	8.3+01	.0	
89	-1.142359+03	5.5+01	.0		90	-4.376880+02	1.6+02	.0	

DAMAGE CRITERION = NONE

INCREMENTAL STIFFNESS 75 % LOADING SUBCASE 2

S T R E S S E S I N R O D E L E M E N T S (C T U B E) (LBS/SQ.IN.)

ELEMENT ID.	AXIAL STRESS	SAFETY MARGIN	TORSIONAL STRESS	SAFETY MARGIN	ELEMENT ID.	AXIAL STRESS	SAFETY MARGIN	TORSIONAL STRESS	SAFETY MARGIN
181	2.395568+01	3.3+03	.0		182	-3.897070+01	1.6+03	.0	
183	3.239319+03	4.9+01	.0		184	2.611281+03	6.0+01	.0	
185	-2.744052+03	4.5+01	.0		186	-3.018602+03	4.2+01	.0	
187	-2.386809+03	2.6+01	.0		188	4.079921+03	1.9+01	.0	
189	2.780331+03	3.0+01	.0		190	-2.732912+03	2.4+01	.0	
191	2.382835+03	3.2+01	.0		192	-4.101758+03	9.9+00	.0	
193	-3.009968+03	2.2+01	.0		194	2.946871+03	2.9+01	.0	
195	2.414355+01	2.3+03	.0		196	-2.158149+02	2.1+02	.0	
197	1.903701+02	2.9+02	.0		198	-4.125977+01	1.1+03	.0	
199	-1.326468+03	1.0+02	.0		200	-5.622070+01	2.8+03	.0	
201	1.283807+03	1.3+02	.0		202	3.316406+00	6.3+04	.0	
203	8.250781+01	1.1+03	.0		204	-1.261562+02	5.9+02	.0	
205	3.740170+03	4.8+01	.0		206	2.346828+03	7.8+01	.0	
207	-2.569798+03	5.7+01	.0		208	-3.613542+03	3.9+01	.0	
209	-2.140976+03	3.3+01	.0		210	4.286477+03	2.1+01	.0	
211	3.359109+03	2.9+01	.0		212	-3.306238+03	2.3+01	.0	
213	2.203187+03	4.0+01	.0		214	-4.236790+03	1.7+01	.0	
215	-3.503229+03	2.2+01	.0		216	3.435506+03	2.9+01	.0	
217	-7.655713+02	6.7+01	.0		218	4.720903+02	1.4+02	.0	
219	-4.315557+02	1.2+02	.0		220	8.071997+02	7.9+01	.0	
221	-6.109180+02	2.6+02	.0		222	2.096875+01	1.1+04	.0	
223	8.462617+02	2.3+02	.0		224	4.253906+01	5.8+03	.0	
225	-2.533213+03	3.4+01	.0		226	2.691182+03	4.0+01	.0	

TRUSS TAIL BOOM MODEL1 **A 226 ELEMENT VERSION OCTOBER 28, 1977 NASTRAN 7/15/77 PAGE 52
DAMAGE CRITERION = NONE

INCREMENTAL STIFFNESS 10 SUBCASE 2

S T R E S S E S I N R O D E L E M E N T S (C T U B E) (LBS/SQ.IN.)

ELEMENT ID.	AXIAL STRESS	SAFETY MARGIN	TORSIONAL STRESS	SAFETY MARGIN	ELEMENT ID.	AXIAL STRESS	SAFETY MARGIN	TORSIONAL STRESS	SAFETY MARGIN
181	2.753320+01	2.9+03	.0		182	-5.611230+01	1.1+03	.0	
183	4.363463+03	3.6+01	.0		184	3.449622+03	4.5+01	.0	
185	-3.692930+03	3.3+01	.0		166	-3.980987+03	3.1+01	.0	
187	-3.189072+03	1.9+01	.0		188	5.447357+03	1.4+01	.0	
189	3.726840+03	2.2+01	.0		190	-3.642287+03	1.8+01	.0	
191	3.187286+03	2.4+01	.0		192	-5.479344+03	7.2+00	.0	
193	-4.036521+03	1.6+01	.0		194	3.924226+03	2.1+01	.0	
195	3.050977+01	1.8+03	.0		196	-2.915430+02	1.5+02	.0	
197	2.502441+02	2.2+02	.0		198	-5.584814+01	8.0+02	.0	
199	-1.777078+03	7.6+01	.0		200	-1.057500+02	1.5+03	.0	
201	1.710539+03	1.0+02	.0		202	1.213281+01	1.7+04	.0	
203	9.987695+01	9.4+02	.0		204	-1.774834+02	4.2+02	.0	
205	5.017898+03	3.5+01	.0		206	3.088778+03	5.9+01	.0	
207	-3.470639+03	4.2+01	.0		208	-4.784399+03	3.0+01	.0	
209	-2.852751+03	2.5+01	.0		210	5.732853+03	1.5+01	.0	
211	4.500035+03	2.1+01	.0		212	-4.406020+03	1.7+01	.0	
213	2.956884+03	3.0+01	.0		214	-5.652594+03	1.2+01	.0	
215	-4.704664+03	1.6+01	.0		216	4.571439+03	2.2+01	.0	
217	-1.009607+03	5.0+01	.0		218	6.345557+02	1.0+02	.0	
219	-5.668281+02	4.2+01	.0		220	1.080805+03	5.9+01	.0	
221	-7.581074+02	2.1+02	.0		222	3.311719+01	7.2+03	.0	
223	1.185168+03	1.7+02	.0		224	7.192578+01	3.4+03	.0	
225	-3.333855+03	2.5+01	.0		226	3.615910+03	2.9+01	.0	

* 85.1 CPU-S 320.6 COR-S 977 ELP-S. 158 OFF END

* 65.2 CPU-S 320.6 COR-S 977 ELP-S. 179 EXIT BEGN

* * * END OF JOB * * *

TRUSS TAIL BOOM MODEL1 **A 226 ELEMENT VERSION OCTOBER 28, 1977 NASTRAN 7/15/77 PAGE 51
DAMAGE CRITERION = NONE

INCREMENTAL STIFFNESS 100% LOADING SUBCASE 2

S T R E S S E S I N R O D E L E M E N T S (C T U B E) (LBS/SQ.IN.)

ELEMENT ID.	AXIAL STRESS	SAFETY MARGIN	TORSIONAL STRESS	SAFETY MARGIN	ELEMENT ID.	AXIAL STRESS	SAFETY MARGIN	TORSIONAL STRESS	SAFETY MARGIN
91	1.143596+03	6.9+01	.0		92	3.808765+02	2.4+02	.0	
93	-1.956738+01	1.7+03	.0		94	-6.420288+00	5.3+03	.0	
95	3.387807+03	2.4+01	.0		96	2.229254+03	3.8+01	.0	
97	-3.253991+03	2.0+01	.0		98	-2.271342+03	2.9+01	.0	
99	-1.730025+03	1.9+01	.0		100	3.370831+03	1.2+01	.0	
101	2.995250+03	1.4+01	.0		102	-2.650071+03	1.3+01	.0	
103	2.662065+03	1.5+01	.0		104	-4.308036+03	7.1+00	.0	
105	-3.202899+03	1.1+01	.0		106	2.837690+03	1.5+01	.0	
107	1.893091+02	1.6+02	.0		108	-3.539541+02	6.7+01	.0	
109	-1.822925+02	1.3+02	.0		110	3.196942+02	9.3+01	.0	
111	-1.215705+03	6.1+01	.0		112	-1.357617+01	6.2+03	.0	
113	1.201986+03	7.7+01	.0		114	-1.704443+01	5.1+03	.0	
115	-6.734375+00	6.9+03	.0		116	-1.480127+01	2.7+03	.0	
117	3.207114+03	3.0+01	.0		118	2.811887+03	3.5+01	.0	
119	-3.106521+03	2.5+01	.0		120	-2.904386+03	2.7+01	.0	
121	-2.358629+03	1.6+01	.0		122	4.149485+03	1.1+01	.0	
123	3.095008+03	1.6+01	.0		124	-2.994922+03	1.3+01	.0	
125	2.365713+03	2.0+01	.0		126	-4.132564+03	8.8+00	.0	
127	-3.312031+03	1.2+01	.0		128	3.207362+03	1.6+01	.0	
129	-6.266064+01	4.5+02	.0		130	-9.464111+01	2.9+02	.0	
131	7.992236+01	4.4+02	.0		132	7.697778+01	4.6+02	.0	
133	-1.335275+03	6.4+01	.0		134	-7.468359+01	1.3+03	.0	
135	1.305969+03	8.2+01	.0		136	4.508789+01	2.8+03	.0	
137	-3.162012+01	1.5+03	.0		138	2.710937+00	2.1+04	.0	
139	3.497457+03	3.2+01	.0		140	3.054913+03	3.7+01	.0	
141	-3.342004+03	2.7+01	.0		142	-3.158396+03	2.9+01	.0	
143	-2.579676+03	1.7+01	.0		144	4.512638+03	1.2+01	.0	
145	3.316531+03	1.8+01	.0		146	-3.230994+03	1.4+01	.0	
147	2.588586+03	2.1+01	.0		148	-4.518240+03	9.5+00	.0	
149	-3.597171+03	1.3+01	.0		150	3.500107+03	1.7+01	.0	
151	-9.355957+01	3.5+02	.0		152	-1.201167+02	2.7+02	.0	
153	1.060498+02	3.9+02	.0		154	8.658984+01	4.7+02	.0	
155	-1.467660+03	6.8+01	.0		156	-8.228125+01	1.4+03	.0	
157	1.446943+03	8.7+01	.0		158	3.158301+01	4.7+03	.0	
159	-7.363281-01	7.4+04	.0		160	-3.389844+01	1.6+03	.0	
161	3.827334+03	3.4+01	.0		162	3.277151+03	4.1+01	.0	
163	-3.570811+03	3.0+01	.0		164	-3.481243+03	3.0+01	.0	
165	-2.802858+03	1.8+01	.0		166	4.948802+03	1.3+01	.0	
167	3.583319+03	1.9+01	.0		168	-3.501463+03	1.6+01	.0	
169	2.821336+03	2.3+01	.0		170	-4.950678+03	1.0+01	.0	
171	-3.902544+03	1.4+01	.0		172	3.801829+03	1.9+01	.0	
173	-6.533867+01	5.8+02	.0		174	-1.267148+02	3.0+02	.0	
175	1.080088+02	4.5+02	.0		176	6.411182+01	7.4+02	.0	
177	-1.582652+03	7.4+01	.0		178	-9.389062+01	1.5+03	.0	
179	1.579355+03	9.2+01	.0		180	3.534180+01	5.0+03	.0	

APPENDIX B

NASTRAN MATHEMATICAL MODEL OF THE UNDAMAGED TRUSS MODEL 2 PLUS OUTPUT OF DISPLACEMENTS, STRESSES AND MARGINS OF SAFETY DUE TO FLIGHT LOADS.

UNIVAC 1100 SERIES
MODEL 1108

RIGID FORMAT SERIES M3

LEVEL 77.1.0

DATE - 7/15/77

SYSTEM GENERATED BY SPERRY SUPPORT SERVICES

24

N A S T R A N   E X E C U T I V E   C O N T R O L   D E C K   E C H O

```
ID ERLINE,MODEL2
APP DISP
$ STATIC ANALYSIS WITH DIFFERENTIAL STIFFNESS RF 4
SOL 4,0
TIME 10
CEND
```

C A S E   C O N T R O L   D E C K   E C H O

```
CARD
COUNT
  1      TITLE = TRUSS TAIL BOOM  MODEL2  **A 114 ELEMENT VERSION
  2      SUBTITLE = DAMAGE CRITION = NONE
  3      OLOAD = ALL
  4      SPC = 10
  5      SPCFORCES = ALL
  6      DISP = ALL
  7      SET 5 = 1 THRU 138
  8          SUBCASE 1
  9          LABEL = LINEAR CASE
 10          LOAD = 11
 11          SUBCASE 2
 12          LABEL = INCREMENTAL STIFFNESS
 13      DSCOEFFICIENT = 200
 14          STRESS = 5
 15      MAXLINES = 100000
 16      BEGIN BULK
```

*** USER INFORMATION MESSAGE 207, BULK DATA NOT SORTED,XSORT WILL RE-ORDER DECK.

S O R T E D   B U L K   D A T A   E C H O

CARD COUNT	. 1 ..	2 ..	3 ..	4 ..	5 .. 6 .. 7 .. 8 .. 9 .. 10 .
1-	CTUBE	1	1	1	2
2-	CTUBE	2	2	1	4
3-	CTUBE	3	3	3	4
4-	CTUBE	4	4	2	3
5-	CTUBE	5	5	1	3
6-	CTUBE	6	6	2	4
7-	CTUBE	7	7	1	5
8-	CTUBE	8	8	2	6
9-	CTUBE	9	9	3	7
10-	CTUBE	10	10	4	8
11-	CTUBE	11	11	1	6
12-	CTUBE	12	12	2	5
13-	CTUBE	13	13	1	8
14-	CTUBE	14	14	4	5
15-	CTUBE	15	15	4	7
16-	CTUBE	16	16	3	8
17-	CTUBE	17	17	2	7
18-	CTUBE	18	18	3	6
19-	CTUBE	23	23	5	6
20-	CTUBE	24	24	5	8
21-	CTUBE	25	25	7	8
22-	CTUBE	26	26	6	7
23-	CTUBE	27	27	5	7
24-	CTUBE	28	28	6	8
25-	CTUBE	29	29	5	9
26-	CTUBE	30	30	6	10
27-	CTUBE	31	31	7	11
28-	CTUBE	32	32	8	12
29-	CTUBE	33	33	5	10
30-	CTUBE	34	34	6	9
31-	CTUBE	35	35	5	12
32-	CTUBE	36	36	8	9
33-	CTUBE	37	37	8	11
34-	CTUBE	38	38	7	12
35-	CTUBE	39	39	6	11
36-	CTUBE	40	40	7	10
37-	CTUBE	45	45	9	10
38-	CTUBE	46	46	9	12
39-	CTUBE	47	47	11	12
40-	CTUBE	48	48	10	11
41-	CTUBE	49	49	9	11
42-	CTUBE	50	50	10	12
43-	CTUBE	51	51	9	13
44-	CTUBE	52	52	10	14
45-	CTUBE	53	53	11	15

DAMAGE CRITION = NONE

S O R T E D   B U L K   D A T A   E C H O

CARD COUNT	. 1 ..	2 ..	3 ..	4 ..	5 ..	6 .. 7 .. 8 .. 9 .. 10 .
46-	CTUBE	54	54	12	16	
47-	CTUBE	55	55	9	14	
48-	CTUBE	56	56	10	13	
49-	CTUBE	57	57	9	16	
50-	CTUBE	58	58	12	13	
51-	CTUBE	59	59	12	15	
52-	CTUBE	60	60	11	16	
53-	CTUBE	61	61	10	15	
54-	CTUBE	62	62	11	14	
55-	CTUBE	67	67	13	14	
56-	CTUBE	68	68	13	16	
57-	CTUBE	69	69	15	16	
58-	CTUBE	70	70	14	15	
59-	CTUBE	71	71	13	15	
60-	CTUBE	72	72	14	16	
61-	CTUBE	73	73	13	17	
62-	CTUBE	74	74	14	18	
63-	CTUBE	75	75	15	19	
64-	CTUBE	76	76	16	20	
65-	CTUBE	77	77	13	18	
66-	CTUBE	78	78	14	17	
67-	CTUBE	79	79	13	20	
68-	CTUBE	80	80	16	17	
69-	CTUBE	81	81	16	19	
70-	CTUBE	82	82	15	20	
71-	CTUBE	83	83	14	19	
72-	CTUBE	84	84	15	18	
73-	CTUBE	89	89	17	18	
74-	CTUBE	90	90	17	20	
75-	CTUBE	91	91	19	20	
76-	CTUBE	92	92	18	19	
77-	CTUBE	93	93	17	19	
78-	CTUBE	94	94	18	20	
79-	CTUBE	95	95	17	21	
80-	CTUBE	96	96	18	22	
81-	CTUBE	97	97	19	23	
82-	CTUBE	98	98	20	24	
83-	CTUBE	99	99	17	22	
84-	CTUBE	100	100	18	21	
85-	CTUBE	101	101	17	24	
86-	CTUBE	102	102	20	21	
87-	CTUBE	103	103	20	23	
88-	CTUBE	104	104	19	24	
89-	CTUBE	105	105	18	23	
90-	CTUBE	106	106	19	22	

TRUSS TAIL BOOM MODEL2 **A 114 ELEMENT VERSION OCTOBER 26, 1977 NASTRAN 7/15/77 PAGE 5
DAMAGE CRITION = NONE

S O R T E D B U L K D A T A E C H O

CARD COUNT	. 1 ..	2 ..	3 ..	4 ..	5 ..	6 ..	7 ..	8 ..	9 ..	10 .
91-	CTUBE	111	111	21	22					
92-	CTUBE	112	112	21	24					
93-	CTUBE	113	113	23	24					
94-	CTUBE	114	114	22	23					
95-	CTUBE	115	115	21	23					
96-	CTUBE	116	116	22	24					
97-	CTUBE	117	117	21	25					
98-	CTUBE	118	118	22	26					
99-	CTUBE	119	119	23	27					
100-	CTUBE	120	120	24	28					
101-	CTUBE	121	121	21	26					
102-	CTUBE	122	122	22	25					
103-	CTUBE	123	123	21	28					
104-	CTUBE	124	124	24	25					
105-	CTUBE	125	125	24	27					
106-	CTUBE	126	126	23	28					
107-	CTUBE	127	127	22	27					
108-	CTUBE	128	128	23	26					
109-	CTUBE	133	133	25	26					
110-	CTUBE	134	134	25	28					
111-	CTUBE	135	135	27	28					
112-	CTUBE	136	136	26	27					
113-	CTUBE	137	137	25	27					
114-	CTUBE	138	138	26	28					
115-	DSFACT	200	1.60422	2.40632	3.20843					
116-	FORCE	11	13	0	44.2200	.0	0.0	-1.		
117-	FORCE	11	14	0	44.2200	.0	0.0	-1.		
118-	FORCE	11	15	0	44.2200	.0	0.0	-1.		
119-	FORCE	11	16	0	44.2200	.0	0.0	-1.		
120-	FORCE	11	25	0	464.5	1.	.0	.0		
121-	FORCE	11	25	0	527.3	.0	-1.0	.0		
122-	FORCE	11	26	0	464.5	1.0	0.0	.0		
123-	FORCE	11	26	0	527.3	.0	1.	.0		
124-	FORCE	11	27	0	464.5	-1.	0.0	.0		
125-	FORCE	11	27	0	527.5	.0	1.	.0		
126-	FORCE	11	28	0	464.5	-1.	.0	.0		
127-	FORCE	11	28	0	527.3	.0	-1.	.0		
128-	GRDSET							456		
129-	GRID	1		.000	11.95	12.375				
130-	GRID	2		.000	11.75	-12.375				
131-	GRID	3		.000	-11.75	-12.375				
132-	GRID	4		.000	-11.95	12.375				
133-	GRID	5		33.5	10.656	11.105				
134-	GRID	6		33.5	10.485	-11.105				
135-	GRID	7		33.5	-10.485	-11.105				

```
                                    S O R T E D   B U L K   D A T A   E C H O
     CARD
     COUNT        .  1  ..  2  ..  3  ..  4  ..  5  ..  6  ..  7  ..  8  ..  9  ..  10  .
      136-        GRID    8                33.5    -10.666 11.105
      137-        GRID    9                66.5    9.401   9.855
      138-        GRID    10               66.5    9.239   -9.855
      139-        GRID    11               66.5    -9.239  -9.855
      140-        GRID    12               66.5    -9.401  9.855
      141-        GRID    13               99.5    8.136   8.604
      142-        GRID    14               99.5    7.994   -8.604
      143-        GRID    15               99.5    -7.994  -8.604
      144-        GRID    16               99.5    -8.136  8.604
      145-        GRID    17               127.5   7.063   7.543
      146-        GRID    18               127.5   6.937   -7.543
      147-        GRID    19               127.5   -6.937  -7.543
      148-        GRID    20               127.5   -7.063  7.543
      149-        GRID    21               151.5   6.143   6.634
      150-        GRID    22               151.5   6.031   -6.634
      151-        GRID    23               151.5   -6.031  -6.634
      152-        GRID    24               151.5   -6.143  6.634
      153-        GRID    25               173.5   5.3     5.8
      154-        GRID    26               173.5   5.2     -5.8
      155-        GRID    27               173.5   -5.2    -5.8
      156-        GRID    28               173.5   -5.3    5.800
      157-        MAT1    1       10.5E6   3.8E6   .33     .1                                      +MAT001
      158-        +MAT001 4.38+04 3.51+04
      159-        MAT1    2       10.5E6   3.8E6   .33     .1                                      +MAT002
      160-        +MAT002 4.70+04 3.76+04
      161-        MAT1    3       10.5E6   3.8E6   .33     .1                                      +MAT003
      162-        +MAT003 4.38+04 3.51+04
      163-        MAT1    4       10.5E6   3.8E6   .33     .1                                      +MAT004
      164-        +MAT004 4.86+04 3.89+04
      165-        MAT1    5       10.5E6   3.8E6   .33     .1                                      +MAT005
      166-        +MAT005 2.29+04 1.83+04
      167-        MAT1    6       10.5E6   3.8E6   .33     .1                                      +MAT006
      168-        +MAT006 2.29+04 1.83+04
      169-        MAT1    7       10.5E6   3.8E6   .33     .1                                      +MAT007
      170-        +MAT007 2.38+04 1.91+04
      171-        MAT1    8       10.5E6   3.8E6   .33     .1                                      +MAT008
      172-        +MAT008 2.38+04 1.91+04
      173-        MAT1    9       10.5E6   3.8E6   .33     .1                                      +MAT009
      174-        +MAT009 2.38+04 1.91+04
      175-        MAT1    10      10.5E6   3.8E6   .33     .1                                      +MAT010
      176-        +MAT010 2.38+04 1.91+04
      177-        MAT1    11      10.5E6   3.8E6   .33     .1                                      +MAT011
      178-        +MAT011 1.60+04 1.28+04
      179-        MAT1    12      10.5E6   3.8E6   .33     .1                                      +MAT012
      180-        +MAT012 1.60+04 1.28+04
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TRUSS TAIL BOOM  MODEL2  **A 114 ELEMENT VERSION                OCTOBER  26, 1977   NASTRAN  7/15/77    PAGE      7
DAMAGE CRITION = NONE

                                       S O R T E D   B U L K   D A T A   E C H O
            CARD
            COUNT        .  1  ..  2  ..  3  ..  4  ..  5  ..  6  ..  7  ..  8  ..  9  ..  10  .
             181-        MAT1    13      10.5E6  3.8E6   .33     .1                                      +MAT013
             182-        +MAT013 1.64+04 1.31+04
             183-        MAT1    14      10.5E6  3.8E6   .33     .1                                      +MAT014
             184-        +MAT014 1.64+04 1.31+04
             185-        MAT1    15      10.5E6  3.8E6   .33     .1                                      +MAT015
             186-        +MAT015 1.60+04 1.28+04
             187-        MAT1    16      10.5E6  3.8E6   .33     .1                                      +MAT016
             188-        +MAT016 1.60+04 1.28+04
             189-        MAT1    17      10.5E6  3.8E6   .33     .1                                      +MAT017
             190-        +MAT017 1.66+04 1.33+04
             191-        MAT1    18      10.5E6  3.8E6   .33     .1                                      +MAT018
             192-        +MAT018 1.66+04 1.33+04
             193-        MAT1    19      10.5E6  3.8E6   .33     .1                                      +MAT019
             194-        +MAT019 1.23+04 9.86+03
             195-        MAT1    20      10.5E6  3.8E6   .33     .1                                      +MAT020
             196-        +MAT020 1.23+04 9.87+03
             197-        MAT1    21      10.5E6  3.8E6   .33     .1                                      +MAT021
             198-        +MAT021 1.23+04 9.87+03
             199-        MAT1    22      10.5E6  3.8E6   .33     .1                                      +MAT022
             200-        +MAT022 1.23+04 9.86+03
             201-        MAT1    23      10.5E6  3.8E6   .33     .1                                      +MAT023
             202-        +MAT023 5.44+04 4.35+04
             203-        MAT1    24      10.5E6  3.8E6   .33     .1                                      +MAT024
             204-        +MAT024 5.90+04 4.72+04
             205-        MAT1    25      10.5E6  3.8E6   .33     .1                                      +MAT025
             206-        +MAT025 5.44+04 4.35+04
             207-        MAT1    26      10.5E6  3.8E6   .33     .1                                      +MAT026
             208-        +MAT026 6.10+04 4.88+04
             209-        MAT1    27      10.5E6  3.8E6   .33     .1                                      +MAT027
             210-        +MAT027 2.85+04 2.28+04
             211-        MAT1    28      10.5E6  3.8E6   .33     .1                                      +MAT028
             212-        +MAT028 2.85+04 2.28+04
             213-        MAT1    29      10.5E6  3.8E6   .33     .1                                      +MAT029
             214-        +MAT029 2.46+04 1.97+04
             215-        MAT1    30      10.5E6  3.8E6   .33     .1                                      +MAT030
             216-        +MAT030 2.46+04 1.97+04
             217-        MAT1    31      10.5E6  3.8E6   .33     .1                                      +MAT031
             218-        +MAT031 2.46+04 1.97+04
             219-        MAT1    32      10.5E6  3.8E6   .33     .1                                      +MAT032
             220-        +MAT032 2.46+04 1.97+04
             221-        MAT1    33      10.5E6  3.8E6   .33     .1                                      +MAT033
             222-        +MAT033 1.75+04 1.40+04
             223-        MAT1    34      10.5E6  3.8E6   .33     .1                                      +MAT034
             224-        +MAT034 1.75+04 1.40+04
             225-        MAT1    35      10.5E6  3.8E6   .33     .1                                      +MAT035
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SORTED BULK DATA ECHO

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 CARD
 COUNT    .   1  ..   2  ..   3  ..   4  ..   5  ..   6  ..   7  ..   8  ..   9  ..  10  .
  226-    +MAT035  1.80+04 1.44+04
  227-    MAT1     36              10.5E6  3.8E6   .33     .1                                       +MAT036
  228-    +MAT036  1.80+04 1.44+04
  229-    MAT1     37              10.5E6  3.8E6   .33     .1                                       +MAT037
  230-    +MAT037  1.75+04 1.40+04
  231-    MAT1     38              10.5E6  3.8E6   .33     .1                                       +MAT038
  232-    +MAT038  1.75+04 1.40+04
  233-    MAT1     39              10.5E6  3.8E6   .33     .1                                       +MAT039
  234-    +MAT039  1.81+04 1.45+04
  235-    MAT1     40              10.5E6  3.8E6   .33     .1                                       +MAT040
  236-    +MAT040  1.61+04 1.45+04
  237-    MAT1     41              10.5E6  3.8E6   .33     .1                                       +MAT041
  238-    +MAT041  1.39+04 1.12+04
  239-    MAT1     42              10.5E6  3.8E6   .33     .1                                       +MAT042
  240-    +MAT042  1.40+04 1.12+04
  241-    MAT1     43              10.5E6  3.8E6   .33     .1                                       +MAT043
  242-    +MAT043  1.40+04 1.12+04
  243-    MAT1     44              10.5E6  3.8E6   .33     .1                                       +MAT044
  244-    +MAT044  1.39+04 1.12+04
  245-    MAT1     45              10.5E6  3.8E6   .33     .1                                       +MAT045
  246-    +MAT045  6.91+04 5.53+04
  247-    MAT1     46              10.5E6  3.8E6   .33     .1                                       +MAT046
  248-    +MAT046  7.59+04 6.08+04
  249-    MAT1     47              10.5E6  3.8E6   .33     .1                                       +MAT047
  250-    +MAT047  6.91+04 5.53+04
  251-    MAT1     48              10.5E6  3.8E6   .33     .1                                       +MAT048
  252-    +MAT048  7.86+04 6.29+04
  253-    MAT1     49              10.5E6  3.8E6   .33     .1                                       +MAT049
  254-    +MAT049  3.65+04 2.92+04
  255-    MAT1     50              10.5E6  3.8E6   .33     .1                                       +MAT050
  256-    +MAT050  3.65+04 2.92+04
  257-    MAT1     51              10.5E6  3.8E6   .33     .1                                       +MAT051
  258-    +MAT051  2.46+04 1.97+04
  259-    MAT1     52              10.5E6  3.8E6   .33     .1                                       +MAT052
  260-    +MAT052  2.46+04 1.97+04
  261-    MAT1     53              10.5E6  3.8E6   .33     .1                                       +MAT053
  262-    +MAT053  2.46+04 1.97+04
  263-    MAT1     54              10.5E6  3.8E6   .33     .1                                       +MAT054
  264-    +MAT054  2.46+04 1.97+04
  265-    MAT1     55              10.5E6  3.8E6   .33     .1                                       +MAT055
  266-    +MAT055  1.87+04 1.50+04
  267-    MAT1     56              10.5E6  3.8E6   .33     .1                                       +MAT056
  268-    +MAT056  1.88+04 1.50+04
  269-    MAT1     57              10.5E6  3.8E6   .33     .1                                       +MAT057
  270-    +MAT057  1.92+04 1.54+04
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TRUSS TAIL BOOM  MODEL2  **A 114 ELEMENT VERSION                OCTOBER  26, 1977   NASTRAN  7/15/77    PAGE     9
DAMAGE CRITION = NONE

                                   S O R T E D   B U L K   D A T A   E C H O
          CARD
          COUNT       .  1  ..  2  ..  3  ..  4  ..  5  ..  6  ..  7  ..  8  ..  9  ..  10  .
           271-       MAT1    58      10.5E6  3.8E6   .33     .1                              +MAT058
           272-       +MAT058  1.92+04 1.54+04
           273-       MAT1    59      10.5E6  3.8E6   .33     .1                              +MAT059
           274-       +MAT059  1.87+04 1.50+04
           275-       MAT1    60      10.5E6  3.8E6   .33     .1                              +MAT060
           276-       +MAT060  1.88+04 1.50+04
           277-       MAT1    61      10.5E6  3.8E6   .33     .1                              +MAT061
           278-       +MAT061  1.93+04 1.55+04
           279-       MAT1    62      10.5E6  3.8E6   .33     .1                              +MAT062
           280-       +MAT062  1.93+04 1.55+04
           281-       MAT1    63      10.5E6  3.8E6   .33     .1                              +MAT063
           282-       +MAT063  1.55+04 1.24+04
           283-       MAT1    64      10.5E6  3.8E6   .33     .1                              +MAT064
           284-       +MAT064  1.55+04 1.24+04
           285-       MAT1    65      10.5E6  3.8E6   .33     .1                              +MAT065
           286-       +MAT065  1.55+04 1.24+04
           287-       MAT1    66      10.5E6  3.8E6   .33     .1                              +MAT066
           288-       +MAT066  1.55+04 1.24+04
           289-       MAT1    67      10.5E6  3.8E6   .33     .1                              +MAT067
           290-       +MAT067  9.06+04 7.25+04
           291-       MAT1    68      10.5E6  3.8E6   .33     .1                              +MAT068
           292-       +MAT068  1.01+05 8.11+04
           293-       MAT1    69      10.5E6  3.8E6   .33     .1                              +MAT069
           294-       +MAT069  9.06+04 7.25+04
           295-       MAT1    70      10.5E6  3.8E6   .33     .1                              +MAT070
           296-       +MAT070  1.05+05 8.40+04
           297-       MAT1    71      10.5E6  3.8E6   .33     .1                              +MAT071
           298-       +MAT071  4.82+04 3.86+04
           299-       MAT1    72      10.5E6  3.8E6   .33     .1                              +MAT072
           300-       +MAT072  4.82+04 3.86+04
           301-       MAT1    73      10.5E6  3.8E6   .33     .1                              +MAT073
           302-       +MAT073  3.41+04 2.73+04
           303-       MAT1    74      10.5E6  3.8E6   .33     .1                              +MAT074
           304-       +MAT074  3.41+04 2.73+04
           305-       MAT1    75      10.5E6  3.8E6   .33     .1                              +MAT075
           306-       +MAT075  3.41+04 2.73+04
           307-       MAT1    76      10.5E6  3.8E6   .33     .1                              +MAT076
           308-       +MAT076  3.41+04 2.73+04
           309-       MAT1    77      10.5E6  3.8E6   .33     .1                              +MAT077
           310-       +MAT077  2.57+04 2.05+04
           311-       MAT1    78      10.5E6  3.8E6   .33     .1                              +MAT078
           312-       +MAT078  2.57+04 2.05+04
           313-       MAT1    79      10.5E6  3.8E6   .33     .1                              +MAT079
           314-       +MAT079  2.64+04 2.11+04
           315-       MAT1    80      10.5E6  3.8E6   .33     .1                              +MAT080
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                                S O R T E D   B U L K   D A T A   E C H O
      CARD
    . COUNT       .  1  ..  2  ..  3  ..  4  ..  5  ..  6  ..  7  ..  8  ..  9  ..  10  .
       316-       +MAT080  2.64+04 2.11+04
       317-       MAT1    81       10.5E6  3.8E6   .33     .1                              +MAT081
       318-       +MAT081  2.57+04 2.05+04
       319-       MAT1    82       10.5E6  3.8E6   .33     .1                              +MAT082
       320-       +MAT082  2.57+04 2.05+04
       321-       MAT1    83       10.5E6  3.8E6   .33     .1                              +MAT083
       322-       +MAT083  2.66+04 2.13+04
       323-       MAT1    84       10.5E6  3.8E6   .33     .1                              +MAT084
       324-       +MAT084  2.66+04 2.13+04
       325-       MAT1    85       10.5E6  3.8E6   .33     .1                              +MAT085
       326-       +MAT085  2.11+04 1.69+04
       327-       MAT1    86       10.5E6  3.8E6   .33     .1                              +MAT086
       328-       +MAT086  2.11+04 1.69+04
       329-       MAT1    87       10.5E6  3.8E6   .33     .1                              +MAT087
       330-       +MAT087  2.11+04 1.69+04
       331-       MAT1    88       10.5E6  3.8E6   .33     .1                              +MAT088
       332-       +MAT088  2.11+04 1.69+04
       333-       MAT1    89       10.5E6  3.8E6   .33     .1                              +MAT089
       334-       +MAT089  1.18+05 9.43+04
       335-       MAT1    90       10.5E6  3.8E6   .33     .1                              +MAT090
       336-       +MAT090  1.34+05 1.08+05
       337-       MAT1    91       10.5E6  3.8E6   .33     .1                              +MAT091
       338-       +MAT091  1.18+05 9.43+04
       339-       MAT1    92       10.5E6  3.8E6   .33     .1                              +MAT092
       340-       +MAT092  1.40+05 1.12+05
       341-       MAT1    93       10.5E6  3.8E6   .33     .1                              +MAT093
       342-       +MAT093  6.34+04 5.07+04
       343-       MAT1    94       10.5E6  3.8E6   .33     .1                              +MAT094
       344-       +MAT094  6.34+04 5.07+04
       345-       MAT1    95       10.5E6  3.8E6   .33     .1                              +MAT095
       346-       +MAT095  4.65+04 3.72+04
       347-       MAT1    96       10.5E6  3.8E6   .33     .1                              +MAT096
       348-       +MAT096  4.65+04 3.72+04
       349-       MAT1    97       10.5E6  3.8E6   .33     .1                              +MAT097
       350-       +MAT097  4.65+04 3.72+04
       351-       MAT1    98       10.5E6  3.8E6   .33     .1                              +MAT098
       352-       +MAT098  4.65+04 3.72+04
       353-       MAT1    99       10.5E6  3.8E6   .33     .1                              +MAT099
       354-       +MAT099  3.45+04 2.76+04
       355-       MAT1    100      10.5E6  3.8E6   .33     .1                              +MAT100
       356-       +MAT100  3.45+04 2.76+04
       357-       MAT1    101      10.5E6  3.8E6   .33     .1                              +MAT101
       358-       +MAT101  3.57+04 2.86+04
       359-       MAT1    102      10.5E6  3.8E6   .33     .1                              +MAT102
       360-       +MAT102  3.57+04 2.86+04
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DAMAGE CRITION = NONE

S O R T E D   B U L K   D A T A   E C H O

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CARD
COUNT     . 1 ..  2 ..  3 ..  4 ..  5 ..  6 ..  7 ..  8 ..  9 ..  10 .
 361-     MAT1    103     10.5E6  3.8E6   .33     .1                              +MAT103
 362-     +MAT103 3.45+04 2.76+04
 363-     MAT1    104     10.5E6  3.8E6   .33     .1                              +MAT104
 364-     +MAT104 3.45+04 2.76+04
 365-     MAT1    105     10.5E6  3.8E6   .33     .1                              +MAT105
 366-     +MAT105 3.60+04 2.88+04
 367-     MAT1    106     10.5E6  3.8E6   .33     .1                              +MAT106
 368-     +MAT106 3.60+04 2.88+04
 369-     MAT1    107     10.5E6  3.8E6   .33     .1                              +MAT107
 370-     +MAT107 2.83+04 2.26+04
 371-     MAT1    108     10.5E6  3.8E6   .33     .1                              +MAT108
 372-     +MAT108 2.83+04 2.27+04
 373-     MAT1    109     10.5E6  3.8E6   .33     .1                              +MAT109
 374-     +MAT109 2.83+04 2.27+04
 375-     MAT1    110     10.5E6  3.8E6   .33     .1                              +MAT110
 376-     +MAT110 2.83+04 2.26+04
 377-     MAT1    111     10.5E6  3.8E6   .33     .1                              +MAT111
 378-     +MAT111 1.52+05 1.22+05
 379-     MAT1    112     10.5E6  3.8E6   .33     .1                              +MAT112
 380-     +MAT112 1.78+05 1.42+05
 381-     MAT1    113     10.5E6  3.8E6   .33     .1                              +MAT113
 382-     +MAT113 1.52+05 1.22+05
 383-     MAT1    114     10.5E6  3.8E6   .33     .1                              +MAT114
 384-     +MAT114 1.85+05 1.48+05
 385-     MAT1    115     10.5E6  3.8E6   .33     .1                              +MAT115
 386-     +MAT115 8.28+04 6.62+04
 387-     MAT1    116     10.5E6  3.8E6   .33     .1                              +MAT116
 388-     +MAT116 8.28+04 6.62+04
 389-     MAT1    117     10.5E6  3.8E6   .33     .1                              +MAT117
 390-     +MAT117 5.53+04 4.42+04
 391-     MAT1    118     10.5E6  3.8E6   .33     .1                              +MAT118
 392-     +MAT118 5.53+04 4.42+04
 393-     MAT1    119     10.5E6  3.8E6   .33     .1                              +MAT119
 394-     +MAT119 5.53+04 4.42+04
 395-     MAT1    120     10.5E6  3.8E6   .33     .1                              +MAT120
 396-     +MAT120 5.53+04 4.42+04
 397-     MAT1    121     10.5E6  3.8E6   .33     .1                              +MAT121
 398-     +MAT121 4.20+04 3.36+04
 399-     MAT1    122     10.5E6  3.8E6   .33     .1                              +MAT122
 400-     +MAT122 4.20+04 3.36+04
 401-     MAT1    123     10.5E6  3.8E6   .33     .1                              +MAT123
 402-     +MAT123 4.36+04 3.49+04
 403-     MAT1    124     10.5E6  3.8E6   .33     .1                              +MAT124
 404-     +MAT124 4.36+04 3.49+04
 405-     MAT1    125     10.5E6  3.8E6   .33     .1                              +MAT125
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DAMAGE CRITION = NONE

                          S O R T E D   B U L K   D A T A   E C H O
 CARD
 COUNT         .   1  ..   2  ..   3  ..   4  ..   5  ..   6  ..   7  ..   8  ..   9  ..  10  .
  406-         +MAT125  4.20+04 3.36+04
  407-         MAT1    126     10.5E6  3.8E6   .33     .1                                      +MAT126
  408-         +MAT126  4.20+04 3.36+04
  409-         MAT1    127     10.5E6  3.8E6   .33     .1                                      +MAT127
  410-         +MAT127  4.40+04 3.52+04
  411-         MAT1    128     10.5E6  3.8E6   .33     .1                                      +MAT128
  412-         +MAT128  4.40+04 3.52+04
  413-         MAT1    129     10.5E6  3.8E6   .33     .1                                      +MAT129
  414-         +MAT129  3.50+04 2.80+04
  415-         MAT1    130     10.5E6  3.8E6   .33     .1                                      +MAT130
  416-         +MAT130  3.50+04 2.80+04
  417-         MAT1    131     10.5E6  3.8E6   .33     .1                                      +MAT131
  418-         +MAT131  3.50+04 2.80+04
  419-         MAT1    132     10.5E6  3.8E6   .33     .1                                      +MAT132
  420-         +MAT132  3.50+04 2.80+04
  421-         MAT1    133     10.5E6  3.8E6   .33     .1                                      +MAT133
  422-         +MAT133  1.99+05 1.60+05
  423-         MAT1    134     10.5E6  3.8E6   .33     .1                                      +MAT134
  424-         +MAT134  2.39+05 1.91+05
  425-         MAT1    135     10.5E6  3.8E6   .33     .1                                      +MAT135
  426-         +MAT135  1.99+05 1.60+05
  427-         MAT1    136     10.5E6  3.8E6   .33     .1                                      +MAT136
  428-         +MAT136  2.48+05 1.99+05
  429-         MAT1    137     10.5E6  3.8E6   .33     .1                                      +MAT137
  430-         +MAT137  1.10+05 8.77+04
  431-         MAT1    138     10.5E6  3.8E6   .33     .1                                      +MAT138
  432-         +MAT138  1.10+05 8.77+04
  433-         PARAM   GRDPNT  0
  434-         PTUBE   1       1       1.5     .0625
  435-         PTUBE   2       2       1.5     .0625
  436-         PTUBE   3       3       1.5     .0625
  437-         PTUBE   4       4       1.5     .0625
  438-         PTUBE   5       5       1.5     .0625
  439-         PTUBE   6       6       1.5     .0625
  440-         PTUBE   7       7       1.5     .0625
  441-         PTUBE   8       8       1.5     .0625
  442-         PTUBE   9       9       1.5     .0625
  443-         PTUBE   10      10      1.5     .0625
  444-         PTUBE   11      11      1.5     .0625
  445-         PTUBE   12      12      1.5     .0625
  446-         PTUBE   13      13      1.5     .0625
  447-         PTUBE   14      14      1.5     .0625
  448-         PTUBE   15      15      1.5     .0625
  449-         PTUBE   16      16      1.5     .0625
  450-         PTUBE   17      17      1.5     .0625
```

SORTED BULK DATA ECHO

CARD COUNT	. 1 ..	2 ..	3 ..	4 ..	5 .. 6 .. 7 .. 8 .. 9 .. 10 .
451-	PTUBE	18	18	1.5	.0625
452-	PTUBE	19	19	1.5	.0625
453-	PTUBE	20	20	1.5	.0625
454-	PTUBE	21	21	1.5	.0625
455-	PTUBE	22	22	1.5	.0625
456-	PTUBE	23	23	1.5	.0625
457-	PTUBE	24	24	1.5	.0625
458-	PTUBE	25	25	1.5	.0625
459-	PTUBE	26	26	1.5	.0625
460-	PTUBE	27	27	1.5	.0625
461-	PTUBE	28	28	1.5	.0625
462-	PTUBE	29	29	1.5	.0625
463-	PTUBE	30	30	1.5	.0625
464-	PTUBE	31	31	1.5	.0625
465-	PTUBE	32	32	1.5	.0625
466-	PTUBE	33	33	1.5	.0625
467-	PTUBE	34	34	1.5	.0625
468-	PTUBE	35	35	1.5	.0625
469-	PTUBE	36	36	1.5	.0625
470-	PTUBE	37	37	1.5	.0625
471-	PTUBE	38	38	1.5	.0625
472-	PTUBE	39	39	1.5	.0625
473-	PTUBE	40	40	1.5	.0625
474-	PTUBE	41	41	1.5	.0625
475-	PTUBE	42	42	1.5	.0625
476-	PTUBE	43	43	1.5	.0625
477-	PTUBE	44	44	1.5	.0625
478-	PTUBE	45	45	1.5	.0625
479-	PTUBE	46	46	1.5	.0625
480-	PTUBE	47	47	1.5	.0625
481-	PTUBE	48	48	1.5	.0625
482-	PTUBE	49	49	1.5	.0625
483-	PTUBE	50	50	1.5	.0625
484-	PTUBE	51	51	1.5	.0625
485-	PTUBE	52	52	1.5	.0625
486-	PTUBE	53	53	1.5	.0625
487-	PTUBE	54	54	1.5	.0625
488-	PTUBE	55	55	1.5	.0625
489-	PTUBE	56	56	1.5	.0625
490-	PTUBE	57	57	1.5	.0625
491-	PTUBE	58	58	1.5	.0625
492-	PTUBE	59	59	1.5	.0625
493-	PTUBE	60	60	1.5	.0625
494-	PTUBE	61	61	1.5	.0625
495-	PTUBE	62	62	1.5	.0625

S O R T E D   B U L K   D A T A   E C H O

CARD COUNT	. 1 ..	2 ..	3 ..	4 ..	5 ..	6 .. 7 .. 8 .. 9 .. 10 .
496-	PTUBE	63	63	1.5	.0625	
497-	PTUBE	64	64	1.5	.0625	
498-	PTUBE	65	65	1.5	.0625	
499-	PTUBE	66	66	1.5	.0625	
500-	PTUBE	67	67	1.5	.0625	
501-	PTUBE	68	68	1.5	.0625	
502-	PTUBE	69	69	1.5	.0625	
503-	PTUBE	70	70	1.5	.0625	
504-	PTUBE	71	71	1.5	.0625	
505-	PTUBE	72	72	1.5	.0625	
506-	PTUBE	73	73	1.5	.0625	
507-	PTUBE	74	74	1.5	.0625	
508-	PTUBE	75	75	1.5	.0625	
509-	PTUBE	76	76	1.5	.0625	
510-	PTUBE	77	77	1.5	.0625	
511-	PTUBE	78	78	1.5	.0625	
512-	PTUBE	79	79	1.5	.0625	
513-	PTUBE	80	80	1.5	.0625	
514-	PTUBE	81	81	1.5	.0625	
515-	PTUBE	82	82	1.5	.0625	
516-	PTUBE	83	83	1.5	.0625	
517-	PTUBE	84	84	1.5	.0625	
518-	PTUBE	85	85	1.5	.0625	
519-	PTUBE	86	86	1.5	.0625	
520-	PTUBE	87	87	1.5	.0625	
521-	PTUBE	88	88	1.5	.0625	
522-	PTUBE	89	89	1.5	.0625	
523-	PTUBE	90	90	1.5	.0625	
524-	PTUBE	91	91	1.5	.0625	
525-	PTUBE	92	92	1.5	.0625	
526-	PTUBE	93	93	1.5	.0625	
527-	PTUBE	94	94	1.5	.0625	
528-	PTUBE	95	95	1.5	.0625	
529-	PTUBE	96	96	1.5	.0625	
530-	PTUBE	97	97	1.5	.0625	
531-	PTUBE	98	98	1.5	.0625	
532-	PTUBE	99	99	1.5	.0625	
533-	PTUBE	100	100	1.5	.0625	
534-	PTUBE	101	101	1.5	.0625	
535-	PTUBE	102	102	1.5	.0625	
536-	PTUBE	103	103	1.5	.0625	
537-	PTUBE	104	104	1.5	.0625	
538-	PTUBE	105	105	1.5	.0625	
539-	PTUBE	106	106	1.5	.0625	
540-	PTUBE	107	107	1.5	.0625	

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                                   S O R T E D   B U L K   D A T A   E C H O
      CARD
      COUNT        .   1  ..   2  ..   3  ..   4  ..   5  ..   6  ..   7  ..   8  ..   9  ..  10  .
       541-        PTUBE   108      108       1.5      .0625
       542-        PTUBE   109      109       1.5      .0625
       543-        PTUBE   110      110       1.5      .0625
       544-        PTUBE   111      111       1.5      .0625
       545-        PTUBE   112      112       1.5      .0625
       546-        PTUBE   113      113       1.5      .0625
       547-        PTUBE   114      114       1.5      .0625
       548-        PTUBE   115      115       1.5      .0625
       549-        PTUBE   116      116       1.5      .0625
       550-        PTUBE   117      117       1.5      .0625
       551-        PTUBE   118      118       1.5      .0625
       552-        PTUBE   119      119       1.5      .0625
       553-        PTUBE   120      120       1.5      .0625
       554-        PTUBE   121      121       1.5      .0625
       555-        PTUBE   122      122       1.5      .0625
       556-        PTUBE   123      123       1.5      .0625
       557-        PTUBE   124      124       1.5      .0625
       558-        PTUBE   125      125       1.5      .0625
       559-        PTUBE   126      126       1.5      .0625
       560-        PTUBE   127      127       1.5      .0625
       561-        PTUBE   128      128       1.5      .0625
       562-        PTUBE   129      129       1.5      .0625
       563-        PTUBE   130      130       1.5      .0625
       564-        PTUBE   131      131       1.5      .0625
       565-        PTUBE   132      132       1.5      .0625
       566-        PTUBE   133      133       1.5      .0625
       567-        PTUBE   134      134       1.5      .0625
       568-        PTUBE   135      135       1.5      .0625
       569-        PTUBE   136      136       1.5      .0625
       570-        PTUBE   137      137       1.5      .0625
       571-        PTUBE   138      138       1.5      .0625
       572-        SPC     10       1         123456            2         123456
       573-        SPC     10       3         123456            4         123456
                   ENDDATA

 * 11.4 CPU-S  60.4 COR-S    20 ELP-S.     XGPI

       **NO ERRORS FOUND - EXECUTE NASTRAN PROGRAM**

 * 14.6 CPU-S  64.6 COR-S    25 ELP-S.     SEM1  END

 * 14.6 CPU-S  64.6 COR-S    25 ELP-S.     ----  LINK   END   ---
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DAMAGE CRITERION = NONE

LINEAR CASE 30 % LOADING SUBCASE 1

D I S P L A C E M E N T V E C T O R

POINT ID.	TYPE	X (IN)	Y (IN)	Z (IN)	R1	R2	R3
1	G	.0	.0	.0	.0	.0	.0
2	G	.0	.0	.0	.0	.0	.0
3	G	.0	.0	.0	.0	.0	.0
4	G	.0	.0	.0	.0	.0	.0
5	G	3.808960-03	-8.003385-03	5.592414-04	.0	.0	.0
6	G	-6.060912-04	3.930867-03	1.190927-03	.0	.0	.0
7	G	-3.676434-03	3.140641-03	-1.009343-02	.0	.0	.0
8	G	4.968146-04	-7.199159-03	-9.451740-03	.0	.0	.0
9	G	6.587249-03	-2.157185-02	-3.772064-03	.0	.0	.0
10	G	-1.843186-04	2.479580-03	-3.280151-03	.0	.0	.0
11	G	-6.407310-03	2.128899-03	-2.620921-02	.0	.0	.0
12	G	4.528371-05	-2.121480-02	-2.571272-02	.0	.0	.0
13	G	8.108101-03	-4.351839-02	-1.062160-02	.0	.0	.0
14	G	1.290961-03	-4.270602-03	-1.025311-02	.0	.0	.0
15	G	-7.890126-03	-4.350141-03	-4.736535-02	.0	.0	.0
16	G	-1.462164-03	-4.344037-02	-4.699647-02	.0	.0	.0
17	G	9.022580-03	-6.906972-02	-1.564162-02	.0	.0	.0
18	G	2.960545-03	-1.722768-02	-1.537139-02	.0	.0	.0
19	G	-8.760307-03	-1.722553-02	-6.383362-02	.0	.0	.0
20	G	-3.176044-03	-6.907189-02	-6.356338-02	.0	.0	.0
21	G	9.934891-03	-9.789615-02	-2.028055-02	.0	.0	.0
22	G	4.301572-03	-3.529501-02	-2.008361-02	.0	.0	.0
23	G	-9.399123-03	-3.529508-02	-7.764830-02	.0	.0	.0
24	G	-4.790581-03	-9.789609-02	-7.745137-02	.0	.0	.0
25	G	1.061690-02	-1.330094-01	-2.448695-02	.0	.0	.0
26	G	5.548152-03	-5.775276-02	-2.483351-02	.0	.0	.0
27	G	-1.000189-02	-5.775245-02	-8.988068-02	.0	.0	.0
28	G	-6.116372-03	-1.330094-01	-9.022717-02	.0	.0	.0

DAMAGE CRITERION = NONE

INCREMENTAL STIFFNESS 50 % LOADING SUBCASE 2

D I S P L A C E M E N T V E C T O R

POINT ID.	TYPE	X (IN)	Y (IN)	Z (IN)	R1	R2	R3
1	G	.0	.0	.0	.0	.0	.0
2	G	.0	.0	.0	.0	.0	.0
3	G	.0	.0	.0	.0	.0	.0
4	G	.0	.0	.0	.0	.0	.0
5	G	6.255592-03	-1.290247-02	7.447220-04	.0	.0	.0
6	G	-1.076665-03	6.356675-03	1.775518-03	.0	.0	.0
7	G	-6.033014-03	5.046518-03	-1.638145-02	.0	.0	.0
8	G	9.087669-04	-1.154819-02	-1.535603-02	.0	.0	.0
9	G	1.085260-02	-3.477493-02	-6.742868-03	.0	.0	.0
10	G	-4.875443-04	3.973119-03	-5.937379-03	.0	.0	.0
11	G	-1.053797-02	3.383438-03	-4.283017-02	.0	.0	.0
12	G	2.900520-04	-3.413987-02	-4.204186-02	.0	.0	.0
13	G	1.339756-02	-7.019109-02	-1.872231-02	.0	.0	.0
14	G	1.802321-03	-7.002152-03	-1.811730-02	.0	.0	.0
15	G	-1.299832-02	-7.145443-03	-7.783044-02	.0	.0	.0
16	G	-2.029264-03	-7.000571-02	-7.725334-02	.0	.0	.0
17	G	1.493055-02	-1.113359-01	-2.801512-02	.0	.0	.0
18	G	4.429339-03	-2.789172-02	-2.756883-02	.0	.0	.0
19	G	-1.443700-02	-2.789467-02	-1.055399-01	.0	.0	.0
20	G	-4.704782-03	-1.112835-01	-1.051230-01	.0	.0	.0
21	G	1.643311-02	-1.577144-01	-3.683409-02	.0	.0	.0
22	G	6.559625-03	-5.696797-02	-3.649950-02	.0	.0	.0
23	G	-1.547599-02	-5.696326-02	-1.291162-01	.0	.0	.0
24	G	-7.246980-03	-1.576620-01	-1.288238-01	.0	.0	.0
25	G	1.753051-02	-2.141573-01	-4.502065-02	.0	.0	.0
26	G	8.560392-03	-9.308011-02	-4.569347-02	.0	.0	.0
27	G	-1.643499-02	-9.306449-02	-1.503643-01	.0	.0	.0
28	G	-9.362262-03	-2.141306-01	-1.508090-01	.0	.0	.0

DAMAGE CRITERION = NONE

INCREMENTAL STIFFNESS 75 % LOADING SUBCASE 2

D I S P L A C E M E N T V E C T O R

POINT ID.	TYPE	X (IN)	Y (IN)	Z (IN)	R1	R2	R3
1	G	.0	.0	.0	.0	.0	.0
2	G	.0	.0	.0	.0	.0	.0
3	G	.0	.0	.0	.0	.0	.0
4	G	.0	.0	.0	.0	.0	.0
5	G	9.494084-03	-1.940388-02	1.002610-03	.0	.0	.0
6	G	-1.692481-03	9.572472-03	2.562577-03	.0	.0	.0
7	G	-9.152616-03	7.575185-03	-2.471574-02	.0	.0	.0
8	G	1.446179-03	-1.732417-02	-2.318028-02	.0	.0	.0
9	G	1.649621-02	-5.229925-02	-1.063383-02	.0	.0	.0
10	G	-8.737777-04	5.951338-03	-9.412849-03	.0	.0	.0
11	G	-1.600451-02	5.046369-03	-6.483904-02	.0	.0	.0
12	G	5.968494-04	-5.129968-02	-6.366249-02	.0	.0	.0
13	G	2.039370-02	-1.055932-01	-2.934786-02	.0	.0	.0
14	G	2.503719-03	-1.062868-02	-2.842971-02	.0	.0	.0
15	G	-1.975715-02	-1.085544-02	-1.181421-01	.0	.0	.0
16	G	-2.808020-03	-1.052697-01	-1.172873-01	.0	.0	.0
17	G	2.274316-02	-1.674441-01	-4.421894-02	.0	.0	.0
18	G	6.405707-03	-4.204874-02	-4.353985-02	.0	.0	.0
19	G	-2.194762-02	-4.205800-02	-1.606827-01	.0	.0	.0
20	G	-6.765771-03	-1.673204-01	-1.600697-01	.0	.0	.0
21	G	2.502630-02	-2.371250-01	-5.848265-02	.0	.0	.0
22	G	9.585249-03	-8.574011-02	-5.796680-02	.0	.0	.0
23	G	-2.351677-02	-8.572942-02	-1.971170-01	.0	.0	.0
24	G	-1.054286-02	-2.370068-01	-1.966963-01	.0	.0	.0
25	G	2.667450-02	-3.218895-01	-7.184347-02	.0	.0	.0
26	G	1.258687-02	-1.399797-01	-7.294101-02	.0	.0	.0
27	G	-2.494889-02	-1.399448-01	-2.302184-01	.0	.0	.0
28	G	-1.370677-02	-3.218294-01	-2.308019-01	.0	.0	.0

DAMAGE CRITERION = NONE

INCREMENTAL STIFFNESS 100% LOADING SUBCASE 2

D I S P L A C E M E N T V E C T O R

POINT ID.	TYPE	X (IN)	Y (IN)	Z (IN)	R1	R2	R3
1	G	.0	.0	.0	.0	.0	.0
2	G	.0	.0	.0	.0	.0	.0
3	G	.0	.0	.0	.0	.0	.0
4	G	.0	.0	.0	.0	.0	.0
5	G	1.280817-02	-2.594144-02	1.183984-03	.0	.0	.0
6	G	-2.359331-03	1.281287-02	3.282948-03	.0	.0	.0
7	G	-1.234264-02	1.010685-02	-3.314748-02	.0	.0	.0
8	G	2.038312-03	-2.310383-02	-3.110345-02	.0	.0	.0
9	G	2.228807-02	-6.992449-02	-1.487235-02	.0	.0	.0
10	G	-1.353839-03	7.919747-03	-1.322693-02	.0	.0	.0
11	G	-2.160590-02	6.685727-03	-8.724951-02	.0	.0	.0
12	G	1.010485-03	-6.852884-02	-8.568846-02	.0	.0	.0
13	G	2.759259-02	-1.412214-01	-4.081963-02	.0	.0	.0
14	G	3.073342-03	-1.434981-02	-3.958100-02	.0	.0	.0
15	G	-2.669315-02	-1.466845-02	-1.593978-01	.0	.0	.0
16	G	-3.430614-03	-1.407294-01	-1.582725-01	.0	.0	.0
17	G	3.079236-02	-2.238735-01	-6.189306-02	.0	.0	.0
18	G	8.224595-03	-5.636504-02	-6.097465-02	.0	.0	.0
19	G	-2.965747-02	-5.638389-02	-2.174290-01	.0	.0	.0
20	G	-8.633497-03	-2.236561-01	-2.166283-01	.0	.0	.0
21	G	3.387570-02	-3.169543-01	-8.229487-02	.0	.0	.0
22	G	1.244271-02	-1.147303-01	-8.158848-02	.0	.0	.0
23	G	-3.176392-02	-1.147113-01	-2.674441-01	.0	.0	.0
24	G	-1.362108-02	-3.167440-01	-2.669072-01	.0	.0	.0
25	G	3.607561-02	-4.301218-01	-1.015535-01	.0	.0	.0
26	G	1.644532-02	-1.871523-01	-1.031353-01	.0	.0	.0
27	G	-3.366455-02	-1.870905-01	-3.132290-01	.0	.0	.0
28	G	-1.782735-02	-4.300146-01	-3.138955-01	.0	.0	.0

DAMAGE CRITERION = NONE

INCREMENTAL STIFFNESS 50 % LOADING SUBCASE 2

S T R E S S E S I N R O D E L E M E N T S (C T U B E) (LBS/SQ.IN.)

ELEMENT ID.	AXIAL STRESS	SAFETY MARGIN	TORSIONAL STRESS	SAFETY MARGIN	ELEMENT ID.	AXIAL STRESS	SAFETY MARGIN	TORSIONAL STRESS	SAFETY MARGIN
1	.0		.0		2	.0		.0	
3	.0		.0		4	.0		.0	
5	.0		.0		6	.0		.0	
7	2.100756+03	1.0+01	.0		8	-3.904817+02	4.8+01	.0	
9	-2.020083+03	8.5+00	.0		10	3.276187+02	7.2+01	.0	
11	-5.455815+02	2.2+01	.0		12	1.511202+03	9.6+00	.0	
13	1.997594+03	7.2+00	.0		14	-5.341067+02	2.4+01	.0	
15	1.190064+03	1.2+01	.0		16	-2.148195+03	5.0+00	.0	
17	-2.174410+03	5.1+00	.0		18	6.976864+02	2.3+01	.0	
23	-5.614824+02	7.6+01	.0		24	-6.665977+02	7.0+01	.0	
25	5.486782+02	9.8+01	.0		26	6.560154+02	9.2+01	.0	
27	8.185547+00	3.5+03	.0		28	-1.993307+01	1.1+03	.0	
29	1.814436+03	1.3+01	.0		30	1.227732+02	2.0+02	.0	
31	-1.767088+03	1.0+01	.0		32	-1.503503+02	1.3+02	.0	
33	-7.310417+02	1.8+01	.0		34	1.782890+03	8.8+00	.0	
35	1.988491+03	8.1+00	.0		36	-1.045684+03	1.3+01	.0	
37	1.505494+03	1.1+01	.0		38	-2.551441+03	4.5+00	.0	
39	-2.195208+03	5.6+00	.0		40	1.241067+03	1.4+01	.0	
45	-5.987239+02	9.1+01	.0		46	-3.546543+02	1.7+02	.0	
47	5.842102+02	1.2+02	.0		48	3.350825+02	2.3+02	.0	
49	1.237793-01	2.9+05	.0		50	-1.702484+01	1.7+03	.0	
51	1.382209+03	1.7+01	.0		52	7.113932+02	3.4+01	.0	
53	-1.327605+03	1.4+01	.0		54	-7.485229+02	2.5+01	.0	
55	-9.370841+02	1.5+01	.0		56	2.230792+03	7.4+00	.0	
57	2.109965+03	8.1+00	.0		58	-1.718732+03	8.0+00	.0	
59	1.907438+03	8.8+00	.0		60	-3.196176+03	3.7+00	.0	
61	-2.354866+03	5.6+00	.0		62	1.961231+03	8.8+00	.0	
67	-6.872863+02	1.0+02	.0		68	-1.196187+02	6.8+02	.0	
69	6.686064+02	1.3+02	.0		70	9.409235+01	1.1+03	.0	
71	3.891846+00	1.2+04	.0		72	-2.577368+01	1.5+03	.0	
73	1.294431+03	2.5+01	.0		74	1.143274+03	2.9+01	.0	
75	-1.223482+03	2.1+01	.0		76	-1.197003+03	2.2+01	.0	
77	-1.595655+03	1.2+01	.0		78	3.061902+03	7.4+00	.0	
79	2.163459+03	1.1+01	.0		80	-2.123941+03	8.9+00	.0	
81	1.604046+03	1.5+01	.0		82	-3.067136+03	5.7+00	.0	
83	-2.453084+03	7.7+00	.0		84	2.411720+03	1.0+01	.0	
89	-7.956382+02	1.2+02	.0		90	-3.895215+01	2.8+03	.0	
91	7.749082+02	1.5+02	.0		92	2.227783+00	6.3+04	.0	
93	3.378076+01	1.9+03	.0		94	-6.191101+01	8.2+02	.0	
95	1.576733+03	2.8+01	.0		96	1.260624+03	3.6+01	.0	
97	-1.321531+03	2.7+01	.0		98	-1.492953+03	2.4+01	.0	
99	-1.845161+03	1.4+01	.0		100	3.508241+03	8.8+00	.0	
101	2.392293+03	1.4+01	.0		102	-2.347227+03	1.1+01	.0	
103	1.858308+03	1.8+01	.0		104	-3.518415+03	6.8+00	.0	
105	-2.720641+03	9.6+00	.0		106	2.672993+03	1.2+01	.0	

DAMAGE CRITERION = NONE

INCREMENTAL STIFFNESS 50 % LOADING SUBCASE 2

S T R E S S E S   I N   R O D   E L E M E N T S   (C T U B E)   (LBS/SQ.IN.)

ELEMENT ID.	AXIAL STRESS	SAFETY MARGIN	TORSIONAL STRESS	SAFETY MARGIN	ELEMENT ID.	AXIAL STRESS	SAFETY MARGIN	TORSIONAL STRESS	SAFETY MARGIN
111	-9.377385+02	1.3+02	.0		112	-4.484180+01	3.2+03	.0	
113	9.040322+02	1.7+02	.0		114	-4.105469+00	3.6+04	.0	
115	-6.950195+01	9.5+02	.0		116	2.883008+01	2.9+03	.0	
117	1.699178+03	3.2+01	.0		118	1.435480+03	3.8+01	.0	
119	-1.488711+03	2.9+01	.0		120	-1.639735+03	2.6+01	.0	
121	-2.035861+03	1.6+01	.0		122	4.112227+03	9.2+00	.0	
123	2.952771+03	1.4+01	.0		124	-2.920976+03	1.1+01	.0	
125	2.078911+03	1.9+01	.0		126	-4.109003+03	7.2+00	.0	
127	-3.359635+03	9.5+00	.0		128	3.313254+03	1.2+01	.0	
133	-3.357437+02	4.8+02	.0		134	-2.641211+01	7.2+03	.0	
135	5.421074+02	3.7+02	.0		136	-1.577051+01	1.3+04	.0	
137	-2.122560+03	4.0+01	.0		138	2.217000+03	4.9+01	.0	

DAMAGE CRITERION = NONE

INCREMENTAL STIFFNESS 75 % LOADING SUBCASE 2

S T R E S S E S I N R O D E L E M E N T S (C T U B E) (LBS/SQ.IN.)

ELEMENT ID.	AXIAL STRESS	SAFETY MARGIN	TORSIONAL STRESS	SAFETY MARGIN	ELEMENT ID.	AXIAL STRESS	SAFETY MARGIN	TORSIONAL STRESS	SAFETY MARGIN
1	.0		.0		2	.0		.0	
3	.0		.0		4	.0		.0	
5	.0		.0		6	.0		.0	
7	3.187686+03	6.5+00	.0		8	-6.115744+02	3.0+01	.0	
9	-3.063983+03	5.2+00	.0		10	5.190866+02	4.5+01	.0	
11	-8.201653+02	1.5+01	.0		12	2.273543+03	6.0+00	.0	
13	3.015715+03	4.4+00	.0		14	-7.837040+02	1.6+01	.0	
15	1.794626+03	8.0+00	.0		16	-3.226393+03	3.0+00	.0	
17	-3.285988+03	3.0+00	.0		18	1.034262+03	1.5+01	.0	
23	-8.490722+02	5.0+01	.0		24	-1.023673+03	4.5+01	.0	
25	8.217820+02	6.5+01	.0		26	1.000072+03	6.0+01	.0	
27	6.365417+00	4.5+03	.0		28	-3.190088+01	7.1+02	.0	
29	2.761400+03	7.9+00	.0		30	1.592125+02	1.5+02	.0	
31	-2.686425+03	6.3+00	.0		32	-1.961643+02	9.9+01	.0	
33	-1.097874+03	1.2+01	.0		34	2.682151+03	5.5+00	.0	
35	3.004455+03	5.0+00	.0		36	-1.553130+03	8.3+00	.0	
37	2.258808+03	6.7+00	.0		38	-3.833500+03	2.7+00	.0	
39	-3.316035+03	3.4+00	.0		40	1.847235+03	8.8+00	.0	
45	-9.054391+02	6.0+01	.0		46	-5.582087+02	1.1+02	.0	
47	8.734326+02	7.8+01	.0		48	5.142428+02	1.5+02	.0	
49	-7.670166+00	3.8+03	.0		50	-2.998175+01	9.7+02	.0	
51	2.109731+03	1.1+01	.0		52	1.041327+03	2.3+01	.0	
53	-2.022066+03	6.7+00	.0		54	-1.091643+03	1.7+01	.0	
55	-1.407286+03	9.7+00	.0		56	3.352483+03	4.6+00	.0	
57	3.194263+03	5.0+00	.0		58	-2.566785+03	5.0+00	.0	
59	2.866532+03	5.5+00	.0		60	-4.801383+03	2.1+00	.0	
61	-3.553174+03	3.4+00	.0		62	2.922444+03	5.6+00	.0	
67	-1.038335+03	6.9+01	.0		68	-2.087119+02	3.9+02	.0	
69	9.968916+02	9.0+01	.0		70	1.489202+02	7.0+02	.0	
71	-2.793945+00	1.4+04	.0		72	-4.722998+01	8.2+02	.0	
73	1.975413+03	1.6+01	.0		74	1.688493+03	1.9+01	.0	
75	-1.862303+03	1.4+01	.0		76	-1.762807+03	1.4+01	.0	
77	-2.395710+03	7.6+00	.0		78	4.596776+03	4.6+00	.0	
79	3.269676+03	7.1+00	.0		80	-3.172676+03	5.7+00	.0	
81	2.414694+03	9.6+00	.0		82	-4.608497+03	3.4+00	.0	
83	-3.704849+03	4.7+00	.0		84	3.603595+03	6.4+00	.0	
89	-1.201492+03	7.7+01	.0		90	-8.974121+01	1.2+03	.0	
91	1.154734+03	1.0+02	.0		92	7.005859+00	2.0+04	.0	
93	3.989160+01	1.6+03	.0		94	-1.032948+02	4.9+02	.0	
95	2.396922+03	1.8+01	.0		96	1.868239+03	2.4+01	.0	
97	-2.005754+03	1.8+01	.0		98	-2.207851+03	1.6+01	.0	
99	-2.769247+03	9.0+00	.0		100	5.265283+03	5.6+00	.0	
101	3.612022+03	8.9+00	.0		102	-3.510689+03	7.1+00	.0	
103	2.798879+03	1.1+01	.0		104	-5.288227+03	4.2+00	.0	
105	-4.105455+03	6.0+00	.0		106	3.998314+03	8.0+00	.0	

DAMAGE CRITION = NONE

INCREMENTAL STIFFNESS 75 % LOADING SUBCASE 2

S T R E S S E S   I N   R O D   E L E M E N T S   (C T U B E) (LBS/SQ.IN.)

ELEMENT ID.	AXIAL STRESS	SAFETY MARGIN	TORSIONAL STRESS	SAFETY MARGIN	ELEMENT ID.	AXIAL STRESS	SAFETY MARGIN	TORSIONAL STRESS	SAFETY MARGIN
111	-1.419422+03	8.5+01	.0		112	-1.009668+02	1.4+03	.0	
113	1.343428+03	1.1+02	.0		114	-9.303711+00	1.6+04	.0	
115	-1.194492+02	5.5+02	.0		116	2.778809+01	3.0+03	.0	
117	2.571103+03	2.1+01	.0		118	2.133381+03	2.5+01	.0	
119	-2.253350+03	1.9+01	.0		120	-2.437149+03	1.7+01	.0	
121	-3.045770+03	1.0+01	.0		122	6.177823+03	5.8+00	.0	
123	4.449080+03	8.8+00	.0		124	-4.377426+03	7.0+00	.0	
125	3.142815+03	1.2+01	.0		126	-6.170614+03	4.4+00	.0	
127	-5.064699+03	6.0+00	.0		128	4.960231+03	7.9+00	.0	
133	-4.259883+02	3.7+02	.0		134	-5.958594+01	3.2+03	.0	
135	8.910059+02	2.2+02	.0		136	-3.518750+01	5.7+03	.0	
137	-3.142594+03	2.7+01	.0		138	3.355533+03	3.2+01	.0	

TRUSS TAIL BOOM MODEL2 **A 114 ELEMENT VERSION OCTOBER 26, 1977 NASTRAN 7/15/77 PAGE 39

DAMAGE CRITERION = NONE

INCREMENTAL STIFFNESS 100% LOADING SUBCASE 2

S T R E S S E S I N R O D E L E M E N T S (C T U B E) (LBS/SQ.IN.)

ELEMENT ID.	AXIAL STRESS	SAFETY MARGIN	TORSIONAL STRESS	SAFETY MARGIN	ELEMENT ID.	AXIAL STRESS	SAFETY MARGIN	TORSIONAL STRESS	SAFETY MARGIN
1	.0		.0		2	.0		.0	
3	.0		.0		4	.0		.0	
5	.0		.0		6	.0		.0	
7	4.299580+03	4.5+00	.0		8	-8.496977+02	2.1+01	.0	
9	-4.131011+03	3.6+00	.0		10	7.287840+02	3.2+01	.0	
11	-1.095876+03	1.1+01	.0		12	3.040742+03	4.3+00	.0	
13	4.046948+03	3.1+00	.0		14	-1.021666+03	1.2+01	.0	
15	2.378773+03	5.7+00	.0		16	-4.307687+03	2.0+00	.0	
17	-4.414108+03	2.0+00	.0		18	1.362744+03	1.1+01	.0	
23	-1.141541+03	3.7+01	.0		24	-1.396721+03	3.3+01	.0	
25	1.094213+03	4.9+01	.0		26	1.354944+03	4.4+01	.0	
27	4.954224-01	5.8+04	.0		28	-4.518335+01	5.0+02	.0	
29	3.735461+03	5.6+00	.0		30	1.792187+02	1.4+02	.0	
31	-3.630174+03	4.4+00	.0		32	-2.225599+02	8.8+01	.0	
33	-1.465632+03	8.6+00	.0		34	3.587078+03	3.9+00	.0	
35	4.035245+03	3.5+00	.0		36	-2.050409+03	6.0+00	.0	
37	3.012535+03	4.8+00	.0		38	-5.120242+03	1.7+00	.0	
39	-4.452714+03	2.3+00	.0		40	2.443989+03	6.4+00	.0	
45	-1.217320+03	4.4+01	.0		46	-7.794019+02	7.7+01	.0	
47	1.160861+03	5.9+01	.0		48	7.012236+02	1.1+02	.0	
49	-2.084058+01	1.4+03	.0		50	-4.587115+01	6.4+02	.0	
51	2.862065+03	7.6+00	.0		52	1.354219+03	1.7+01	.0	
53	-2.737424+03	6.2+00	.0		54	-1.414088+03	1.3+01	.0	
55	-1.878810+03	7.0+00	.0		56	4.478988+03	3.2+00	.0	
57	4.298674+03	3.5+00	.0		58	-3.407583+03	3.5+00	.0	
59	3.829468+03	3.9+00	.0		60	-6.411950+03	1.3+00	.0	
61	-4.765922+03	2.3+00	.0		62	3.871020+03	4.0+00	.0	
67	-1.394518+03	5.1+01	.0		68	-3.174795+02	2.5+02	.0	
69	1.321283+03	6.8+01	.0		70	2.090032+02	5.0+02	.0	
71	-1.536084+01	2.5+03	.0		72	-7.435474+01	5.2+02	.0	
73	2.679344+03	1.2+01	.0		74	2.216158+03	1.4+01	.0	
75	-2.519567+03	9.8+00	.0		76	-2.306856+03	1.1+01	.0	
77	-3.197721+03	5.4+00	.0		78	6.135022+03	3.2+00	.0	
79	4.392954+03	5.0+00	.0		80	-4.213091+03	4.0+00	.0	
81	3.231589+03	7.0+00	.0		82	-6.155830+03	2.3+00	.0	
83	-4.974166+03	3.3+00	.0		84	4.786650+03	4.6+00	.0	
89	-1.612864+03	5.7+01	.0		90	-1.615684+02	6.7+02	.0	
91	1.529549+03	7.6+01	.0		92	1.426807+01	9.8+03	.0	
93	3.867090+01	1.6+03	.0		94	-1.515894+02	3.3+02	.0	
95	3.238655+03	1.3+01	.0		96	2.460750+03	1.8+01	.0	
97	-2.705912+03	1.3+01	.0		98	-2.901663+03	1.2+01	.0	
99	-3.695076+03	6.5+00	.0		100	7.025193+03	3.9+00	.0	
101	4.848444+03	6.4+00	.0		102	-4.668152+03	5.1+00	.0	
103	3.747856+03	8.2+00	.0		104	-7.066084+03	2.9+00	.0	
105	-5.507550+03	4.2+00	.0		106	5.316936+03	5.8+00	.0	

TRUSS TAIL BOOM MODEL2 **A 114 ELEMENT VERSION OCTOBER 26, 1977 NASTRAN 7/15/77 PAGE 40
DAMAGE CRITERION = NONE

INCREMENTAL STIFFNESS 100% LOADING SUBCASE 2

S T R E S S E S   I N   R O D   E L E M E N T S   (C T U B E) (LBS/SQ.IN.)

ELEMENT ID.	AXIAL STRESS	SAFETY MARGIN	TORSIONAL STRESS	SAFETY MARGIN	ELEMENT ID.	AXIAL STRESS	SAFETY MARGIN	TORSIONAL STRESS	SAFETY MARGIN
111	-1.909799+03	6.3+01	.0		112	-1.797109+02	7.9+02	.0	
113	1.774391+03	3.5+01	.0		114	-1.659277+01	8.9+03	.0	
115	-1.796172+02	3.7+02	.0		116	1.637744+01	5.1+03	.0	
117	3.458084+03	1.5+01	.0		118	2.818036+03	1.9+01	.0	
119	-3.031671+03	1.4+01	.0		120	-3.219545+03	1.3+01	.0	
121	-4.051315+03	7.3+00	.0		122	8.250880+03	4.1+00	.0	
123	5.959820+03	6.3+00	.0		124	-5.832223+03	5.0+00	.0	
125	4.224214+03	8.9+00	.0		126	-8.238140+03	3.1+00	.0	
127	-6.787707+03	4.2+00	.0		128	6.601729+03	5.7+00	.0	
133	-4.641445+02	3.4+02	.0		134	-1.061953+02	1.8+03	.0	
135	1.292254+03	1.5+02	.0		136	-6.237305+01	3.2+03	.0	
137	-4.134330+03	2.0+01	.0		138	4.513631+03	2.3+01	.0	

* 53.2 CPU-S 262.5 COR-S 182 ELP-S. 158 OFP END

* 53.2 CPU-S 263.4 COR-S 182 ELP-S. 179 EXIT BEGN

APPENDIX C

NASTRAN MATHEMATICAL MODEL OF THE UNDAMAGED TRUSS MODEL 3 PLUS OUTPUT OF DISPLACEMENTS, STRESSES AND MARGINS OF SAFETY DUE TO FLIGHT LOADS

PRECEDING PAGE NOT FILMED BLANK

UNIVAC 1100 SERIES
MODEL 1108

RIGID FORMAT SERIES M3

LEVEL 77.1.0

DATE - 7/15/77

SYSTEM GENERATED BY SPERRY SUPPORT SERVICES

24

N A S T R A N   E X E C U T I V E   C O N T R O L   D E C K   E C H O

```
ID ERLINE,MODEL3
APP DISP
$ STATIC ANALYSIS WITH DIFFERENTIAL STIFFNESS RF 4
SOL 4,0
TIME 10
CEND
```

```
                         C A S E   C O N T R O L   D E C K   E C H O
 CARD
 COUNT
   1      TITLE = TRUSS TAIL BOOM  MODEL3  **A 138 ELEMENT VERSION
   2      SUBTITLE = DAMAGE CRITION = NONE
   3      OLOAD = ALL
   4      SPC = 10
   5      DISP = ALL
   6      SPCFORCES = ALL
   7      SET 5 = 1 THRU 138
   8         SUBCASE 1
   9         LABEL = LINEAR CASE
  10         LOAD = 11
  11         SUBCASE 2
  12         LABEL = INCREMENTAL STIFFNESS
  13      DSCOEFFICIENT = 200
  14         STRESS = 5
  15      MAXLINES = 100000
  16      BEGIN BULK
```

```
*** USER INFORMATION MESSAGE 207, BULK DATA NOT SORTED,XSORT WILL RE-ORDER DECK.
```

DAMAGE CRITION = NONE

S O R T E D   B U L K   D A T A   E C H O

```
CARD
COUNT        .   1  ..   2  ..   3  ..   4  ..   5  ..   6  ..   7  ..   8  ..   9  ..  10  .
   1-        CTUBE   1         1         1         2
   2-        CTUBE   2         2         1         4
   3-        CTUBE   3         3         3         4
   4-        CTUBE   4         4         2         3
   5-        CTUBE   5         5         1         3
   6-        CTUBE   6         6         2         4
   7-        CTUBE   7         7         1         5
   8-        CTUBE   8         8         2         6
   9-        CTUBE   9         9         3         7
  10-        CTUBE   10        10        4         8
  11-        CTUBE   11        11        1         6
  12-        CTUBE   12        12        2         5
  13-        CTUBE   13        13        1         8
  14-        CTUBE   14        14        4         5
  15-        CTUBE   15        15        4         7
  16-        CTUBE   16        16        3         8
  17-        CTUBE   17        17        2         7
  18-        CTUBE   18        18        3         6
  19-        CTUBE   19        19        1         7
  20-        CTUBE   20        20        2         8
  21-        CTUBE   21        21        3         5
  22-        CTUBE   22        22        4         6
  23-        CTUBE   23        23        5         6
  24-        CTUBE   24        24        5         8
  25-        CTUBE   25        25        7         8
  26-        CTUBE   26        26        6         7
  27-        CTUBE   27        27        5         7
  28-        CTUBE   28        28        6         8
  29-        CTUBE   29        29        5         9
  30-        CTUBE   30        30        6         10
  31-        CTUBE   31        31        7         11
  32-        CTUBE   32        32        8         12
  33-        CTUBE   33        33        5         10
  34-        CTUBE   34        34        6         9
  35-        CTUBE   35        35        5         12
  36-        CTUBE   36        36        8         9
  37-        CTUBE   37        37        8         11
  38-        CTUBE   38        38        7         12
  39-        CTUBE   39        39        6         11
  40-        CTUBE   40        40        7         10
  41-        CTUBE   41        41        5         11
  42-        CTUBE   42        42        6         12
  43-        CTUBE   43        43        7         9
  44-        CTUBE   44        44        8         10
  45-        CTUBE   45        45        9         10
```

DAMAGE CRITION = NONE

S O R T E D   B U L K   D A T A   E C H O

CARD COUNT	. 1 ..	2 ..	3 ..	4 ..	5 .. 6 .. 7 .. 8 .. 9 .. 10 .
46-	CTUBE	46	46	9	12
47-	CTUBE	47	47	11	12
48-	CTUBE	48	48	10	11
49-	CTUBE	49	49	9	11
50-	CTUBE	50	50	10	12
51-	CTUBE	51	51	9	13
52-	CTUBE	52	52	10	14
53-	CTUBE	53	53	11	15
54-	CTUBE	54	54	12	16
55-	CTUBE	55	55	9	14
56-	CTUBE	56	56	10	13
57-	CTUBE	57	57	9	16
58-	CTUBE	58	58	12	13
59-	CTUBE	59	59	12	15
60-	CTUBE	60	60	11	16
61-	CTUBE	61	61	10	15
62-	CTUBE	62	62	11	14
63-	CTUBE	63	63	9	15
64-	CTUBE	64	64	10	16
65-	CTUBE	65	65	11	13
66-	CTUBE	66	66	12	14
67-	CTUBE	67	67	13	14
68-	CTUBE	68	68	13	16
69-	CTUBE	69	69	15	16
70-	CTUBE	70	70	14	15
71-	CTUBE	71	71	13	15
72-	CTUBE	72	72	14	16
73-	CTUBE	73	73	13	17
74-	CTUBE	74	74	14	18
75-	CTUBE	75	75	15	19
76-	CTUBE	76	76	16	20
77-	CTUBE	77	77	13	18
78-	CTUBE	78	78	14	17
79-	CTUBE	79	79	13	20
80-	CTUBE	80	80	16	17
81-	CTUBE	81	81	16	19
82-	CTUBE	82	82	15	20
83-	CTUBE	83	83	14	19
84-	CTUBE	84	84	15	18
85-	CTUBE	85	85	13	19
86-	CTUBE	86	86	14	20
87-	CTUBE	87	87	15	17
88-	CTUBE	88	88	16	18
89-	CTUBE	89	89	17	18
90-	CTUBE	90	90	17	20

DAMAGE CRITION = NONE

S O R T E D   B U L K   D A T A   E C H O

```
CARD
COUNT     .  1  ..  2  ..  3  ..  4  ..  5  ..  6  ..  7  ..  8  ..  9  ..  10  .
  91-     CTUBE   91     91     19     20
  92-     CTUBE   92     92     18     19
  93-     CTUBE   93     93     17     19
  94-     CTUBE   94     94     18     20
  95-     CTUBE   95     95     17     21
  96-     CTUBE   96     96     18     22
  97-     CTUBE   97     97     19     23
  98-     CTUBE   98     98     20     24
  99-     CTUBE   99     99     17     22
 100-     CTUBE   100    100    18     21
 101-     CTUBE   101    101    17     24
 102-     CTUBE   102    102    20     21
 103-     CTUBE   103    103    20     23
 104-     CTUBE   104    104    19     24
 105-     CTUBE   105    105    18     23
 106-     CTUBE   106    106    19     22
 107-     CTUBE   107    107    17     23
 108-     CTUBE   108    108    18     24
 109-     CTUBE   109    109    19     21
 110-     CTUBE   110    110    20     22
 111-     CTUBE   111    111    21     22
 112-     CTUBE   112    112    21     24
 113-     CTUBE   113    113    23     24
 114-     CTUBE   114    114    22     23
 115-     CTUBE   115    115    21     23
 116-     CTUBE   116    116    22     24
 117-     CTUBE   117    117    21     25
 118-     CTUBE   118    118    22     26
 119-     CTUBE   119    119    23     27
 120-     CTUBE   120    120    24     28
 121-     CTUBE   121    121    21     26
 122-     CTUBE   122    122    22     25
 123-     CTUBE   123    123    21     28
 124-     CTUBE   124    124    24     25
 125-     CTUBE   125    125    24     27
 126-     CTUBE   126    126    23     28
 127-     CTUBE   127    127    22     27
 128-     CTUBE   128    128    23     26
 129-     CTUBE   129    129    21     27
 130-     CTUBE   130    130    22     28
 131-     CTUBE   131    131    23     25
 132-     CTUBE   132    132    24     26
 133-     CTUBE   133    133    25     26
 134-     CTUBE   134    134    25     28
 135-     CTUBE   135    135    27     28
```

DAMAGE CRITION = NONE

S O R T E D   B U L K   D A T A   E C H O

CARD COUNT	. 1 ..	2 ..	3 ..	4 ..	5 ..	6 ..	7 ..	8 ..	9 ..	10 .
136-	CTUBE	136	136	26	27					
137-	CTUBE	137	137	25	27					
138-	CTUBE	138	138	26	28					
139-	DSFACT	200	1.60422	2.40632	3.20843					
140-	FORCE	11	13	0	44.2200	.0	0.0	-1.		
141-	FORCE	11	14	0	44.2200	.0	0.0	-1.		
142-	FORCE	11	15	0	44.2200	.0	0.0	-1.		
143-	FORCE	11	16	0	44.2200	.0	0.0	-1.		
144-	FORCE	11	25	0	464.5	1.	.0	.0		
145-	FORCE	11	25	0	527.3	.0	-1.0	.0		
146-	FORCE	11	26	0	464.5	1.0	0.0	.0		
147-	FORCE	11	26	0	527.3	.0	1.	.0		
148-	FORCE	11	27	0	464.5	-1.	0.0	.0		
149-	FORCE	11	27	0	527.5	.0	1.	.0		
150-	FORCE	11	28	0	464.5	-1.	.0	.0		
151-	FORCE	11	28	0	527.3	.0	-1.	.0		
152-	GRDSET							456		
153-	GRID	1		.000	11.95	12.375				
154-	GRID	2		.000	11.75	-12.375				
155-	GRID	3		.000	-11.75	-12.375				
156-	GRID	4		.000	-11.95	12.375				
157-	GRID	5		33.5	10.666	11.105				
158-	GRID	6		33.5	10.485	-11.105				
159-	GRID	7		33.5	-10.485	-11.105				
160-	GRID	8		33.5	-10.666	11.105				
161-	GRID	9		66.5	9.401	9.855				
162-	GRID	10		66.5	9.239	-9.855				
163-	GRID	11		66.5	-9.239	-9.855				
164-	GRID	12		66.5	-9.401	9.855				
165-	GRID	13		99.5	8.136	8.604				
166-	GRID	14		99.5	7.994	-8.604				
167-	GRID	15		99.5	-7.994	-8.604				
168-	GRID	16		99.5	-8.136	8.604				
169-	GRID	17		127.5	7.063	7.543				
170-	GRID	18		127.5	6.937	-7.543				
171-	GRID	19		127.5	-6.937	-7.543				
172-	GRID	20		127.5	-7.063	7.543				
173-	GRID	21		151.5	6.143	6.634				
174-	GRID	22		151.5	6.031	-6.634				
175-	GRID	23		151.5	-6.031	-6.634				
176-	GRID	24		151.5	-6.143	6.634				
177-	GRID	25		173.5	5.3	5.8				
178-	GRID	26		173.5	5.2	-5.8				
179-	GRID	27		173.5	-5.2	-5.8				
180-	GRID	28		173.5	-5.3	5.800				

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                              S O R T E D   B U L K   D A T A   E C H O
CARD
COUNT        .  1  ..  2  ..  3  ..  4  ..  5  ..  6  ..  7  ..  8  ..  9  ..  10  .
 181-        MAT1     1        10.5E6  3.8E6   .33     .1                          +MAT001
 182-        +MAT001  4.38+04  3.51+04
 183-        MAT1     2        10.5E6  3.8E6   .33     .1                          +MAT002
 184-        +MAT002  4.70+04  3.76+04
 185-        MAT1     3        10.5E6  3.8E6   .33     .1                          +MAT003
 186-        +MAT003  4.38+04  3.51+04
 187-        MAT1     4        10.5E6  3.8E6   .33     .1                          +MAT004
 188-        +MAT004  4.86+04  3.89+04
 189-        MAT1     5        10.5E6  3.8E6   .33     .1                          +MAT005
 190-        +MAT005  2.29+04  1.83+04
 191-        MAT1     6        10.5E6  3.8E6   .33     .1                          +MAT006
 192-        +MAT006  2.29+04  1.83+04
 193-        MAT1     7        10.5E6  3.8E6   .33     .1                          +MAT007
 194-        +MAT007  2.38+04  1.91+04
 195-        MAT1     8        10.5E6  3.8E6   .33     .1                          +MAT008
 196-        +MAT008  2.38+04  1.91+04
 197-        MAT1     9        10.5E6  3.8E6   .33     .1                          +MAT009
 198-        +MAT009  2.38+04  1.91+04
 199-        MAT1     10       10.5E6  3.8E6   .33     .1                          +MAT010
 200-        +MAT010  2.38+04  1.91+04
 201-        MAT1     11       10.5E6  3.8E6   .33     .1                          +MAT011
 202-        +MAT011  1.60+04  1.28+04
 203-        MAT1     12       10.5E6  3.8E6   .33     .1                          +MAT012
 204-        +MAT012  1.60+04  1.28+04
 205-        MAT1     13       10.5E6  3.8E6   .33     .1                          +MAT013
 206-        +MAT013  1.64+04  1.31+04
 207-        MAT1     14       10.5E6  3.8E6   .33     .1                          +MAT014
 208-        +MAT014  1.64+04  1.31+04
 209-        MAT1     15       10.5E6  3.8E6   .33     .1                          +MAT015
 210-        +MAT015  1.60+04  1.28+04
 211-        MAT1     16       10.5E6  3.8E6   .33     .1                          +MAT016
 212-        +MAT016  1.60+04  1.28+04
 213-        MAT1     17       10.5E6  3.8E6   .33     .1                          +MAT017
 214-        +MAT017  1.66+04  1.33+04
 215-        MAT1     18       10.5E6  3.8E6   .33     .1                          +MAT018
 216-        +MAT018  1.66+04  1.33+04
 217-        MAT1     19       10.5E6  3.8E6   .33     .1                          +MAT019
 218-        +MAT019  1.23+04  9.86+03
 219-        MAT1     20       10.5E6  3.8E6   .33     .1                          +MAT020
 220-        +MAT020  1.23+04  9.87+03
 221-        MAT1     21       10.5E6  3.8E6   .33     .1                          +MAT021
 222-        +MAT021  1.23+04  9.87+03
 223-        MAT1     22       10.5E6  3.8E6   .33     .1                          +MAT022
 224-        +MAT022  1.23+04  9.86+03
 225-        MAT1     23       10.5E6  3.8E6   .33     .1                          +MAT023
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DAMAGE CRITION = NONE

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                         S O R T E D   B U L K   D A T A   E C H O
 CARD
 COUNT      .  1  ..  2  ..  3  ..  4  ..  5  ..  6  ..  7  ..  8  ..  9  ..  10  .
  226-      +MAT023  5.44+04 4.35+04
  227-      MAT1     24      10.5E6  3.8E6   .33     .1                              +MAT024
  228-      +MAT024  5.90+04 4.72+04
  229-      MAT1     25      10.5E6  3.8E6   .33     .1                              +MAT025
  230-      +MAT025  5.44+04 4.35+04
  231-      MAT1     26      10.5E6  3.8E6   .33     .1                              +MAT026
  232-      +MAT026  6.10+04 4.88+04
  233-      MAT1     27      10.5E6  3.8E6   .33     .1                              +MAT027
  234-      +MAT027  2.85+04 2.28+04
  235-      MAT1     28      10.5E6  3.8E6   .33     .1                              +MAT028
  236-      +MAT028  2.85+04 2.28+04
  237-      MAT1     29      10.5E6  3.8E6   .33     .1                              +MAT029
  238-      +MAT029  2.46+04 1.97+04
  239-      MAT1     30      10.5E6  3.8E6   .33     .1                              +MAT030
  240-      +MAT030  2.46+04 1.97+04
  241-      MAT1     31      10.5E6  3.8E6   .33     .1                              +MAT031
  242-      +MAT031  2.46+04 1.97+04
  243-      MAT1     32      10.5E6  3.8E6   .33     .1                              +MAT032
  244-      +MAT032  2.46+04 1.97+04
  245-      MAT1     33      10.5E6  3.8E6   .33     .1                              +MAT033
  246-      +MAT033  1.75+04 1.40+04
  247-      MAT1     34      10.5E6  3.8E6   .33     .1                              +MAT034
  248-      +MAT034  1.75+04 1.40+04
  249-      MAT1     35      10.5E6  3.8E6   .33     .1                              +MAT035
  250-      +MAT035  1.80+04 1.44+04
  251-      MAT1     36      10.5E6  3.8E6   .33     .1                              +MAT036
  252-      +MAT036  1.80+04 1.44+04
  253-      MAT1     37      10.5E6  3.8E6   .33     .1                              +MAT037
  254-      +MAT037  1.75+04 1.40+04
  255-      MAT1     38      10.5E6  3.8E6   .33     .1                              +MAT038
  256-      +MAT038  1.75+04 1.40+04
  257-      MAT1     39      10.5E6  3.8E6   .33     .1                              +MAT039
  258-      +MAT039  1.81+04 1.45+04
  259-      MAT1     40      10.5E6  3.8E6   .33     .1                              +MAT040
  260-      +MAT040  1.81+04 1.45+04
  261-      MAT1     41      10.5E6  3.8E6   .33     .1                              +MAT041
  262-      +MAT041  1.39+04 1.12+04
  263-      MAT1     42      10.5E6  3.8E6   .33     .1                              +MAT042
  264-      +MAT042  1.40+04 1.12+04
  265-      MAT1     43      10.5E6  3.8E6   .33     .1                              +MAT043
  266-      +MAT043  1.40+04 1.12+04
  267-      MAT1     44      10.5E6  3.8E6   .33     .1                              +MAT044
  268-      +MAT044  1.39+04 1.12+04
  269-      MAT1     45      10.5E6  3.8E6   .33     .1                              +MAT045
  270-      +MAT045  6.91+04 5.53+04
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TRUSS TAIL BOOM MODEL3 **A 138 ELEMENT VERSION OCTOBER 26, 1977 NASTRAN 7/15/77 PAGE 9
DAMAGE CRITION = NONE

S O R T E D B U L K D A T A E C H O

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CARD
COUNT        . 1 .. 2 .. 3 .. 4 .. 5 .. 6 .. 7 .. 8 .. 9 .. 10 .
  271-       MAT1    46      10.5E6  3.8E6   .33     .1                              +MAT046
  272-       +MAT046 7.59+04 6.08+04
  273-       MAT1    47      10.5E6  3.8E6   .33     .1                              +MAT047
  274-       +MAT047 6.91+04 5.53+04
  275-       MAT1    48      10.5E6  3.8E6   .33     .1                              +MAT048
  276-       +MAT048 7.86+04 6.29+04
  277-       MAT1    49      10.5E6  3.8E6   .33     .1                              +MAT049
  278-       +MAT049 3.65+04 2.92+04
  279-       MAT1    50      10.5E6  3.8E6   .33     .1                              +MAT050
  280-       +MAT050 3.65+04 2.92+04
  281-       MAT1    51      10.5E6  3.8E6   .33     .1                              +MAT051
  282-       +MAT051 2.46+04 1.97+04
  283-       MAT1    52      10.5E6  3.8E6   .33     .1                              +MAT052
  284-       +MAT052 2.46+04 1.97+04
  285-       MAT1    53      10.5E6  3.8E6   .33     .1                              +MAT053
  286-       +MAT053 2.46+04 1.97+04
  287-       MAT1    54      10.5E6  3.8E6   .33     .1                              +MAT054
  288-       +MAT054 2.46+04 1.97+04
  289-       MAT1    55      10.5E6  3.8E6   .33     .1                              +MAT055
  290-       +MAT055 1.87+04 1.50+04
  291-       MAT1    56      10.5E6  3.8E6   .33     .1                              +MAT056
  292-       +MAT056 1.88+04 1.50+04
  293-       MAT1    57      10.5E6  3.8E6   .33     .1                              +MAT057
  294-       +MAT057 1.92+04 1.54+04
  295-       MAT1    58      10.5E6  3.8E6   .33     .1                              +MAT058
  296-       +MAT058 1.92+04 1.54+04
  297-       MAT1    59      10.5E6  3.8E6   .33     .1                              +MAT059
  298-       +MAT059 1.87+04 1.50+04
  299-       MAT1    60      10.5E6  3.8E6   .33     .1                              +MAT060
  300-       +MAT060 1.88+04 1.50+04
  301-       MAT1    61      10.5E6  3.8E6   .33     .1                              +MAT061
  302-       +MAT061 1.93+04 1.55+04
  303-       MAT1    62      10.5E6  3.8E6   .33     .1                              +MAT062
  304-       +MAT062 1.93+04 1.55+04
  305-       MAT1    63      10.5E6  3.8E6   .33     .1                              +MAT063
  306-       +MAT063 1.55+04 1.24+04
  307-       MAT1    64      10.5E6  3.8E6   .33     .1                              +MAT064
  308-       +MAT064 1.55+04 1.24+04
  309-       MAT1    65      10.5E6  3.8E6   .33     .1                              +MAT065
  310-       +MAT065 1.55+04 1.24+04
  311-       MAT1    66      10.5E6  3.8E6   .33     .1                              +MAT066
  312-       +MAT066 1.55+04 1.24+04
  313-       MAT1    67      10.5E6  3.8E6   .33     .1                              +MAT067
  314-       +MAT067 9.06+04 7.25+04
  315-       MAT1    68      10.5E6  3.8E6   .33     .1                              +MAT068
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                                S O R T E D   B U L K   D A T A   E C H O
CARD
COUNT     .  1  ..  2  ..  3  ..  4  ..  5  ..  6  ..  7  ..  8  ..  9  ..  10  .
 316-     +MAT068  1.01+05 8.11+04
 317-     MAT1    69      10.5E6  3.8E6   .33     .1                              +MAT069
 318-     +MAT069  9.06+04 7.25+04
 319-     MAT1    70      10.5E6  3.8E6   .33     .1                              +MAT070
 320-     +MAT070  1.05+05 8.40+04
 321-     MAT1    71      10.5E6  3.8E6   .33     .1                              +MAT071
 322-     +MAT071  4.82+04 3.86+04
 323-     MAT1    72      10.5E6  3.8E6   .33     .1                              +MAT072
 324-     +MAT072  4.82+04 3.86+04
 325-     MAT1    73      10.5E6  3.8E6   .33     .1                              +MAT073
 326-     +MAT073  3.41+04 2.73+04
 327-     MAT1    74      10.5E6  3.8E6   .33     .1                              +MAT074
 328-     +MAT074  3.41+04 2.73+04
 329-     MAT1    75      10.5E6  3.8E6   .33     .1                              +MAT075
 330-     +MAT075  3.41+04 2.73+04
 331-     MAT1    76      10.5E6  3.8E6   .33     .1                              +MAT076
 332-     +MAT076  3.41+04 2.73+04
 333-     MAT1    77      10.5E6  3.8E6   .33     .1                              +MAT077
 334-     +MAT077  2.57+04 2.05+04
 335-     MAT1    78      10.5E6  3.8E6   .33     .1                              +MAT078
 336-     +MAT078  2.57+04 2.05+04
 337-     MAT1    79      10.5E6  3.8E6   .33     .1                              +MAT079
 338-     +MAT079  2.64+04 2.11+04
 339-     MAT1    80      10.5E6  3.8E6   .33     .1                              +MAT080
 340-     +MAT080  2.64+04 2.11+04
 341-     MAT1    81      10.5E6  3.8E6   .33     .1                              +MAT081
 342-     +MAT081  2.57+04 2.05+04
 343-     MAT1    82      10.5E6  3.8E6   .33     .1                              +MAT082
 344-     +MAT082  2.57+04 2.05+04
 345-     MAT1    83      10.5E6  3.8E6   .33     .1                              +MAT083
 346-     +MAT083  2.66+04 2.13+04
 347-     MAT1    84      10.5E6  3.8E6   .33     .1                              +MAT084
 348-     +MAT084  2.66+04 2.13+04
 349-     MAT1    85      10.5E6  3.8E6   .33     .1                              +MAT085
 350-     +MAT085  2.11+04 1.69+04
 351-     MAT1    86      10.5E6  3.8E6   .33     .1                              +MAT086
 352-     +MAT086  2.11+04 1.69+04
 353-     MAT1    87      10.5E6  3.8E6   .33     .1                              +MAT087
 354-     +MAT087  2.11+04 1.69+04
 355-     MAT1    88      10.5E6  3.8E6   .33     .1                              +MAT088
 356-     +MAT088  2.11+04 1.69+04
 357-     MAT1    89      10.5E6  3.8E6   .33     .1                              +MAT089
 358-     +MAT089  1.18+05 9.43+04
 359-     MAT1    90      10.5E6  3.8E6   .33     .1                              +MAT090
 360-     +MAT090  1.34+05 1.08+05
```

S O R T E D   B U L K   D A T A   E C H O

```
CARD
COUNT       .   1  ..   2  ..   3  ..   4  ..   5  ..   6  ..   7  ..   8  ..   9  ..  10  .
  361-      MAT1     91      10.5E6  3.8E6   .33     .1                                      +MAT091
  362-      +MAT091  1.18+05 9.43+04
  363-      MAT1     92      10.5E6  3.8E6   .33     .1                                      +MAT092
  364-      +MAT092  1.40+05 1.12+05
  365-      MAT1     93      10.5E6  3.8E6   .33     .1                                      +MAT093
  366-      +MAT093  6.34+04 5.07+04
  367-      MAT1     94      10.5E6  3.8E6   .33     .1                                      +MAT094
  368-      +MAT094  6.34+04 5.07+04
  369-      MAT1     95      10.5E6  3.8E6   .33     .1                                      +MAT095
  370-      +MAT095  4.65+04 3.72+04
  371-      MAT1     96      10.5E6  3.8E6   .33     .1                                      +MAT096
  372-      +MAT096  4.65+04 3.72+04
  373-      MAT1     97      10.5E6  3.8E6   .33     .1                                      +MAT097
  374-      +MAT097  4.65+04 3.72+04
  375-      MAT1     98      10.5E6  3.8E6   .33     .1                                      +MAT098
  376-      +MAT098  4.65+04 3.72+04
  377-      MAT1     99      10.5E6  3.8E6   .33     .1                                      +MAT099
  378-      +MAT099  3.45+04 2.76+04
  379-      MAT1     100     10.5E6  3.8E6   .33     .1                                      +MAT100
  380-      +MAT100  3.45+04 2.76+04
  381-      MAT1     101     10.5E6  3.8E6   .33     .1                                      +MAT101
  382-      +MAT101  3.57+04 2.86+04
  383-      MAT1     102     10.5E6  3.8E6   .33     .1                                      +MAT102
  384-      +MAT102  3.57+04 2.86+04
  385-      MAT1     103     10.5E6  3.8E6   .33     .1                                      +MAT103
  386-      +MAT103  3.45+04 2.76+04
  387-      MAT1     104     10.5E6  3.8E6   .33     .1                                      +MAT104
  388-      +MAT104  3.45+04 2.76+04
  389-      MAT1     105     10.5E6  3.8E6   .33     .1                                      +MAT105
  390-      +MAT105  3.60+04 2.88+04
  391-      MAT1     106     10.5E6  3.8E6   .33     .1                                      +MAT106
  392-      +MAT106  3.60+04 2.88+04
  393-      MAT1     107     10.5E6  3.8E6   .33     .1                                      +MAT107
  394-      +MAT107  2.83+04 2.26+04
  395-      MAT1     108     10.5E6  3.8E6   .33     .1                                      +MAT108
  396-      +MAT108  2.83+04 2.27+04
  397-      MAT1     109     10.5E6  3.8E6   .33     .1                                      +MAT109
  398-      +MAT109  2.83+04 2.27+04
  399-      MAT1     110     10.5E6  3.8E6   .33     .1                                      +MAT110
  400-      +MAT110  2.83+04 2.26+04
  401-      MAT1     111     10.5E6  3.8E6   .33     .1                                      +MAT111
  402-      +MAT111  1.52+05 1.22+05
  403-      MAT1     112     10.5E6  3.8E6   .33     .1                                      +MAT112
  404-      +MAT112  1.78+05 1.42+05
  405-      MAT1     113     10.5E6  3.8E6   .33     .1                                      +MAT113
```

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                         S O R T E D   B U L K   D A T A   E C H O
 CARD
 COUNT       .  1  ..  2  ..  3  ..  4  ..  5  ..  6  ..  7  ..  8  ..  9  ..  10  .
  406-       +MAT113  1.52+05 1.22+05
  407-       MAT1     114     10.5E6  3.8E6   .33     .1                             +MAT114
  408-       +MAT114  1.85+05 1.48+05
  409-       MAT1     115     10.5E6  3.8E6   .33     .1                             +MAT115
  410-       +MAT115  8.28+04 6.62+04
  411-       MAT1     116     10.5E6  3.8E6   .33     .1                             +MAT116
  412-       +MAT116  8.28+04 6.62+04
  413-       MAT1     117     10.5E6  3.8E6   .33     .1                             +MAT117
  414-       +MAT117  5.53+04 4.42+04
  415-       MAT1     118     10.5E6  3.8E6   .33     .1                             +MAT118
  416-       +MAT118  5.53+04 4.42+04
  417-       MAT1     119     10.5E6  3.8E6   .33     .1                             +MAT119
  418-       +MAT119  5.53+04 4.42+04
  419-       MAT1     120     10.5E6  3.8E6   .33     .1                             +MAT120
  420-       +MAT120  5.53+04 4.42+04
  421-       MAT1     121     10.5E6  3.8E6   .33     .1                             +MAT121
  422-       +MAT121  4.20+04 3.36+04
  423-       MAT1     122     10.5E6  3.8E6   .33     .1                             +MAT122
  424-       +MAT122  4.20+04 3.36+04
  425-       MAT1     123     10.5E6  3.8E6   .33     .1                             +MAT123
  426-       +MAT123  4.36+04 3.49+04
  427-       MAT1     124     10.5E6  3.8E6   .33     .1                             +MAT124
  428-       +MAT124  4.36+04 3.49+04
  429-       MAT1     125     10.5E6  3.8E6   .33     .1                             +MAT125
  430-       +MAT125  4.20+04 3.36+04
  431-       MAT1     126     10.5E6  3.8E6   .33     .1                             +MAT126
  432-       +MAT126  4.20+04 3.36+04
  433-       MAT1     127     10.5E6  3.8E6   .33     .1                             +MAT127
  434-       +MAT127  4.40+04 3.52+04
  435-       MAT1     128     10.5E6  3.8E6   .33     .1                             +MAT128
  436-       +MAT128  4.40+04 3.52+04
  437-       MAT1     129     10.5E6  3.8E6   .33     .1                             +MAT129
  438-       +MAT129  3.50+04 2.80+04
  439-       MAT1     130     10.5E6  3.8E6   .33     .1                             +MAT130
  440-       +MAT130  3.50+04 2.80+04
  441-       MAT1     131     10.5E6  3.8E6   .33     .1                             +MAT131
  442-       +MAT131  3.50+04 2.80+04
  443-       MAT1     132     10.5E6  3.8E6   .33     .1                             +MAT132
  444-       +MAT132  3.50+04 2.80+04
  445-       MAT1     133     10.5E6  3.8E6   .33     .1                             +MAT133
  446-       +MAT133  1.99+05 1.60+05
  447-       MAT1     134     10.5E6  3.8E6   .33     .1                             +MAT134
  448-       +MAT134  2.39+05 1.91+05
  449-       MAT1     135     10.5E6  3.8E6   .33     .1                             +MAT135
  450-       +MAT135  1.99+05 1.60+05
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S O R T E D   B U L K   D A T A   E C H O

```
CARD
COUNT      . 1 .. 2 .. 3 .. 4 .. 5 .. 6 .. 7 .. 8 .. 9 .. 10 .
 451-      MAT1    136     10.5E6  3.8E6   .33     .1                                      +MAT136
 452-      +MAT136 2.48+05 1.99+05
 453-      MAT1    137     10.5E6  3.8E6   .33     .1                                      +MAT137
 454-      +MAT137 1.10+05 8.77+04
 455-      MAT1    138     10.5E6  3.8E6   .33     .1                                      +MAT138
 456-      +MAT138 1.10+05 8.77+04
 457-      PARAM   GRDPNT  0
 458-      PTUBE   1       1       1.5     .0625
 459-      PTUBE   2       2       1.5     .0625
 460-      PTUBE   3       3       1.5     .0625
 461-      PTUBE   4       4       1.5     .0625
 462-      PTUBE   5       5       1.5     .0625
 463-      PTUBE   6       6       1.5     .0625
 464-      PTUBE   7       7       1.5     .0625
 465-      PTUBE   8       8       1.5     .0625
 466-      PTUBE   9       9       1.5     .0625
 467-      PTUBE   10      10      1.5     .0625
 468-      PTUBE   11      11      1.5     .0625
 469-      PTUBE   12      12      1.5     .0625
 470-      PTUBE   13      13      1.5     .0625
 471-      PTUBE   14      14      1.5     .0625
 472-      PTUBE   15      15      1.5     .0625
 473-      PTUBE   16      16      1.5     .0625
 474-      PTUBE   17      17      1.5     .0625
 475-      PTUBE   18      18      1.5     .0625
 476-      PTUBE   19      19      1.5     .0625
 477-      PTUBE   20      20      1.5     .0625
 478-      PTUBE   21      21      1.5     .0625
 479-      PTUBE   22      22      1.5     .0625
 480-      PTUBE   23      23      1.5     .0625
 481-      PTUBE   24      24      1.5     .0625
 482-      PTUBE   25      25      1.5     .0625
 483-      PTUBE   26      26      1.5     .0625
 484-      PTUBE   27      27      1.5     .0625
 485-      PTUBE   28      28      1.5     .0625
 486-      PTUBE   29      29      1.5     .0625
 487-      PTUBE   30      30      1.5     .0625
 488-      PTUBE   31      31      1.5     .0625
 489-      PTUBE   32      32      1.5     .0625
 490-      PTUBE   33      33      1.5     .0625
 491-      PTUBE   34      34      1.5     .0625
 492-      PTUBE   35      35      1.5     .0625
 493-      PTUBE   36      36      1.5     .0625
 494-      PTUBE   37      37      1.5     .0625
 495-      PTUBE   38      38      1.5     .0625
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S O R T E D B U L K D A T A E C H O

CARD COUNT	. 1 ..	2 ..	3 ..	4 ..	5 .. 6 .. 7 .. 8 .. 9 .. 10 .
496-	PTUBE	39	39	1.5	.0625
497-	PTUBE	40	40	1.5	.0625
498-	PTUBE	41	41	1.5	.0625
499-	PTUBE	42	42	1.5	.0625
500-	PTUBE	43	43	1.5	.0625
501-	PTUBE	44	44	1.5	.0625
502-	PTUBE	45	45	1.5	.0625
503-	PTUBE	46	46	1.5	.0625
504-	PTUBE	47	47	1.5	.0625
505-	PTUBE	48	48	1.5	.0625
506-	PTUBE	49	49	1.5	.0625
507-	PTUBE	50	50	1.5	.0625
508-	PTUBE	51	51	1.5	.0625
509-	PTUBE	52	52	1.5	.0625
510-	PTUBE	53	53	1.5	.0625
511-	PTUBE	54	54	1.5	.0625
512-	PTUBE	55	55	1.5	.0625
513-	PTUBE	56	56	1.5	.0625
514-	PTUBE	57	57	1.5	.0625
515-	PTUBE	58	58	1.5	.0625
516-	PTUBE	59	59	1.5	.0625
517-	PTUBE	60	60	1.5	.0625
518-	PTUBE	61	61	1.5	.0625
519-	PTUBE	62	62	1.5	.0625
520-	PTUBE	63	63	1.5	.0625
521-	PTUBE	64	64	1.5	.0625
522-	PTUBE	65	65	1.5	.0625
523-	PTUBE	66	66	1.5	.0625
524-	PTUBE	67	67	1.5	.0625
525-	PTUBE	68	68	1.5	.0625
526-	PTUBE	69	69	1.5	.0625
527-	PTUBE	70	70	1.5	.0625
528-	PTUBE	71	71	1.5	.0625
529-	PTUBE	72	72	1.5	.0625
530-	PTUBE	73	73	1.5	.0625
531-	PTUBE	74	74	1.5	.0625
532-	PTUBE	75	75	1.5	.0625
533-	PTUBE	76	76	1.5	.0625
534-	PTUBE	77	77	1.5	.0625
535-	PTUBE	78	78	1.5	.0625
536-	PTUBE	79	79	1.5	.0625
537-	PTUBE	80	80	1.5	.0625
538-	PTUBE	81	81	1.5	.0625
539-	PTUBE	82	82	1.5	.0625
540-	PTUBE	83	83	1.5	.0625

DAMAGE CRITION = NONE

SORTED BULK DATA ECHO

CARD COUNT	. 1 ..	2 ..	3 ..	4 ..	5 ..	6 ..	7 ..	8 ..	9 ..	10 .
541-	PTUBE	84	84	1.5	.0625					
542-	PTUBE	85	85	1.5	.0625					
543-	PTUBE	86	86	1.5	.0625					
544-	PTUBE	87	87	1.5	.0625					
545-	PTUBE	88	88	1.5	.0625					
546-	PTUBE	89	89	1.5	.0625					
547-	PTUBE	90	90	1.5	.0625					
548-	PTUBE	91	91	1.5	.0625					
549-	PTUBE	92	92	1.5	.0625					
550-	PTUBE	93	93	1.5	.0625					
551-	PTUBE	94	94	1.5	.0625					
552-	PTUBE	95	95	1.5	.0625					
553-	PTUBE	96	96	1.5	.0625					
554-	PTUBE	97	97	1.5	.0625					
555-	PTUBE	98	98	1.5	.0625					
556-	PTUBE	99	99	1.5	.0625					
557-	PTUBE	100	100	1.5	.0625					
558-	PTUBE	101	101	1.5	.0625					
559-	PTUBE	102	102	1.5	.0625					
560-	PTUBE	103	103	1.5	.0625					
561-	PTUBE	104	104	1.5	.0625					
562-	PTUBE	105	105	1.5	.0625					
563-	PTUBE	106	106	1.5	.0625					
564-	PTUBE	107	107	1.5	.0625					
565-	PTUBE	108	108	1.5	.0625					
566-	PTUBE	109	109	1.5	.0625					
567-	PTUBE	110	110	1.5	.0625					
568-	PTUBE	111	111	1.5	.0625					
569-	PTUBE	112	112	1.5	.0625					
570-	PTUBE	113	113	1.5	.0625					
571-	PTUBE	114	114	1.5	.0625					
572-	PTUBE	115	115	1.5	.0625					
573-	PTUBE	116	116	1.5	.0625					
574-	PTUBE	117	117	1.5	.0625					
575-	PTUBE	118	118	1.5	.0625					
576-	PTUBE	119	119	1.5	.0625					
577-	PTUBE	120	120	1.5	.0625					
578-	PTUBE	121	121	1.5	.0625					
579-	PTUBE	122	122	1.5	.0625					
580-	PTUBE	123	123	1.5	.0625					
581-	PTUBE	124	124	1.5	.0625					
582-	PTUBE	125	125	1.5	.0625					
583-	PTUBE	126	126	1.5	.0625					
584-	PTUBE	127	127	1.5	.0625					
585-	PTUBE	128	128	1.5	.0625					

```
DAMAGE CRITION = NONE

                         S O R T E D   B U L K   D A T A   E C H O
CARD
COUNT       .  1  ..  2  ..  3  ..  4  ..  5  ..  6  ..  7  ..  8  ..  9  ..  10  .
  586-      PTUBE   129     129     1.5     .0625
  587-      PTUBE   130     130     1.5     .0625
  588-      PTUBE   131     131     1.5     .0625
  589-      PTUBE   132     132     1.5     .0625
  590-      PTUBE   133     133     1.5     .0625
  591-      PTUBE   134     134     1.5     .0625
  592-      PTUBE   135     135     1.5     .0625
  593-      PTUBE   136     136     1.5     .0625
  594-      PTUBE   137     137     1.5     .0625
  595-      PTUBE   138     138     1.5     .0625
  596-      SPC     10      1       123456          2       123456
  597-      SPC     10      3       123456          4       123456
            ENDDATA

* 12.0 CPU-S  61.0 COR-S   83 ELP-S.    XGPI

     **NO ERRORS FOUND - EXECUTE NASTRAN PROGRAM**

* 15.3 CPU-S  65.3 COR-S   87 ELP-S.    SEM1  END

* 15.3 CPU-S  65.6 COR-S   87 ELP-S.    ----  LINK   END  ---
```

DAMAGE CRITERION = NONE

LINEAR CASE 30 % LOADING SUBCASE 1

D I S P L A C E M E N T   V E C T O R

POINT ID.	TYPE	X (IN)	Y (IN)	Z (IN)	R1	R2	R3
1	G	.0	.0	.0	.0	.0	.0
2	G	.0	.0	.0	.0	.0	.0
3	G	.0	.0	.0	.0	.0	.0
4	G	.0	.0	.0	.0	.0	.0
5	G	3.824586-03	-8.002697-03	1.239147-03	.0	.0	.0
6	G	-6.296042-04	3.914426-03	1.846044-03	.0	.0	.0
7	G	-3.698554-03	3.156076-03	-9.398228-03	.0	.0	.0
8	G	5.239937-04	-7.229598-03	-8.782766-03	.0	.0	.0
9	G	6.610921-03	-2.175839-02	-2.567162-03	.0	.0	.0
10	G	-2.368843-04	2.303234-03	-2.075979-03	.0	.0	.0
11	G	-6.435060-03	1.945657-03	-2.499642-02	.0	.0	.0
12	G	9.741511-05	-2.139398-02	-2.450107-02	.0	.0	.0
13	G	8.146073-03	-4.387943-02	-8.707179-03	.0	.0	.0
14	G	1.206440-03	-4.716482-03	-8.338110-03	.0	.0	.0
15	G	-7.925483-03	-4.710570-03	-4.543954-02	.0	.0	.0
16	G	-1.385646-03	-4.388691-02	-4.507126-02	.0	.0	.0
17	G	9.036864-03	-6.966224-02	-1.391069-02	.0	.0	.0
18	G	2.886190-03	-1.779398-02	-1.364049-02	.0	.0	.0
19	G	-8.772825-03	-1.779401-02	-6.206533-02	.0	.0	.0
20	G	-3.109049-03	-6.966215-02	-6.179508-02	.0	.0	.0
21	G	9.857841-03	-9.855769-02	-1.861497-02	.0	.0	.0
22	G	4.305520-03	-3.607603-02	-1.843069-02	.0	.0	.0
23	G	-9.480291-03	-3.607603-02	-7.607050-02	.0	.0	.0
24	G	-4.641886-03	-9.855770-02	-7.588623-02	.0	.0	.0
25	G	1.072468-02	-1.339295-01	-2.298322-02	.0	.0	.0
26	G	5.354045-03	-5.878662-02	-2.328369-02	.0	.0	.0
27	G	-9.875625-03	-5.878632-02	-8.844667-02	.0	.0	.0
28	G	-6.161880-03	-1.339296-01	-8.874706-02	.0	.0	.0

DAMAGE CRITERION = NONE

INCREMENTAL STIFFNESS 50 % LOADING SUBCASE 2

D I S P L A C E M E N T V E C T O R

POINT ID.	TYPE	X (IN)	Y (IN)	Z (IN)	R1	R2	R3
1	G	.0	.0	.0	.0	.0	.0
2	G	.0	.0	.0	.0	.0	.0
3	G	.0	.0	.0	.0	.0	.0
4	G	.0	.0	.0	.0	.0	.0
5	G	6.281367-03	-1.290758-02	1.840769-03	.0	.0	.0
6	G	-1.113541-03	6.320952-03	2.833394-03	.0	.0	.0
7	G	-6.069280-03	5.062479-03	-1.526184-02	.0	.0	.0
8	G	9.528196-04	-1.160466-02	-1.427592-02	.0	.0	.0
9	G	1.089392-02	-3.508677-02	-4.808997-03	.0	.0	.0
10	G	-5.700293-04	3.676014-03	-4.001624-03	.0	.0	.0
11	G	-1.058286-02	3.073215-03	-4.088399-02	.0	.0	.0
12	G	3.735691-04	-3.443918-02	-4.009303-02	.0	.0	.0
13	G	1.346446-02	-7.077503-02	-1.564776-02	.0	.0	.0
14	G	1.670188-03	-7.724496-03	-1.504323-02	.0	.0	.0
15	G	-1.305685-02	-7.732561-03	-7.473497-02	.0	.0	.0
16	G	-1.906340-03	-7.072629-02	-7.415868-02	.0	.0	.0
17	G	1.496082-02	-1.123012-01	-2.523106-02	.0	.0	.0
18	G	4.313699-03	-2.881596-02	-2.478546-02	.0	.0	.0
19	G	-1.445805-02	-2.882510-02	-1.026948-01	.0	.0	.0
20	G	-4.594557-03	-1.122454-01	-1.022772-01	.0	.0	.0
21	G	1.631946-02	-1.588013-01	-3.414978-02	.0	.0	.0
22	G	6.570183-03	-5.824551-02	-3.383663-02	.0	.0	.0
23	G	-1.560526-02	-5.824007-02	-1.265726-01	.0	.0	.0
24	G	-7.003218-03	-1.587456-01	-1.262994-01	.0	.0	.0
25	G	1.770963-02	-2.156645-01	-4.258951-02	.0	.0	.0
26	G	8.250180-03	-9.476994-02	-4.318600-02	.0	.0	.0
27	G	-1.623571-02	-9.475413-02	-1.480426-01	.0	.0	.0
28	G	-9.431505-03	-2.156395-01	-1.484158-01	.0	.0	.0

TRUSS TAIL BOOM MODEL3 **A 138 ELEMENT VERSION OCTOBER 26, 1977 NASTRAN 7/15/77 PAGE 31

DAMAGE CRITERION = NONE

INCREMENTAL STIFFNESS 75 % LOADING SUBCASE 2

D I S P L A C E M E N T   V E C T O R

POINT ID.	TYPE	X (IN)	Y (IN)	Z (IN)	R1	R2	R3
1	G	.0	.0	.0	.0	.0	.0
2	G	.0	.0	.0	.0	.0	.0
3	G	.0	.0	.0	.0	.0	.0
4	G	.0	.0	.0	.0	.0	.0
5	G	9.533282-03	-1.941618-02	2.650673-03	.0	.0	.0
6	G	-1.747135-03	9.511817-03	4.154578-03	.0	.0	.0
7	G	-9.267624-03	7.592465-03	-2.303305-02	.0	.0	.0
8	G	1.512604-03	-1.741457-02	-2.155492-02	.0	.0	.0
9	G	1.656074-02	-5.277652-02	-7.732364-03	.0	.0	.0
10	G	-9.960997-04	5.494815-03	-6.506245-03	.0	.0	.0
11	G	-1.607215-02	4.568615-03	-6.191937-02	.0	.0	.0
12	G	7.220333-04	-5.175763-02	-6.073546-02	.0	.0	.0
13	G	2.049857-02	-1.064728-01	-2.473355-02	.0	.0	.0
14	G	2.308141-03	-1.171781-02	-2.381716-02	.0	.0	.0
15	G	-1.984633-02	-1.174316-02	-1.134944-01	.0	.0	.0
16	G	-2.623525-03	-1.063539-01	-1.126407-01	.0	.0	.0
17	G	2.279416-02	-1.689005-01	-4.003750-02	.0	.0	.0
18	G	6.235000-03	-4.344740-02	-3.935992-02	.0	.0	.0
19	G	-2.197997-02	-4.346799-02	-1.564087-01	.0	.0	.0
20	G	-6.598385-03	-1.687749-01	-1.557942-01	.0	.0	.0
21	G	2.486342-02	-2.387751-01	-5.444707-02	.0	.0	.0
22	G	9.604235-03	-8.767548-02	-5.396424-02	.0	.0	.0
23	G	-2.370997-02	-8.766325-02	-1.932925-01	.0	.0	.0
24	G	-1.017334-02	-2.386495-01	-1.928997-01	.0	.0	.0
25	G	2.694789-02	-3.241742-01	-6.818286-02	.0	.0	.0
26	G	1.212250-02	-1.425386-01	-6.916410-02	.0	.0	.0
27	G	-2.465255-02	-1.425034-01	-2.267200-01	.0	.0	.0
28	G	-1.380776-02	-3.241178-01	-2.271980-01	.0	.0	.0

TRUSS TAIL BOOM MODELS **A 138 ELEMENT VERSION OCTOBER 26, 1977 NASTRAN 7/15/77 PAGE 32
DAMAGE CRITERION = NONE

INCREMENTAL STIFFNESS 100% LOADING SUBCASE 2

D I S P L A C E M E N T   V E C T O R

POINT ID.	TYPE	X (IN)	Y (IN)	Z (IN)	R1	R2	R3
1	G	.0	.0	.0	.0	.0	.0
2	G	.0	.0	.0	.0	.0	.0
3	G	.0	.0	.0	.0	.0	.0
4	G	.0	.0	.0	.0	.0	.0
5	G	1.286115-02	-2.596397-02	3.386742-03	.0	.0	.0
6	G	-2.431297-03	1.272251-02	5.412542-03	.0	.0	.0
7	G	-1.241681-02	1.012095-02	-3.089950-02	.0	.0	.0
8	G	2.127547-03	-2.323194-02	-2.892935-02	.0	.0	.0
9	G	2.237754-02	-7.057362-02	-1.100286-02	.0	.0	.0
10	G	-1.515039-03	7.296367-03	-9.347485-03	.0	.0	.0
11	G	-2.169648-02	6.031951-03	-8.335608-02	.0	.0	.0
12	G	1.177266-03	-6.915148-02	-8.178067-02	.0	.0	.0
13	G	2.773650-02	-1.423995-01	-3.466389-02	.0	.0	.0
14	G	2.816091-03	-1.580974-02	-3.342902-02	.0	.0	.0
15	G	-2.681393-02	-1.586134-02	-1.531947-01	.0	.0	.0
16	G	-3.184492-03	-1.421796-01	-1.520707-01	.0	.0	.0
17	G	3.086790-02	-2.258348-01	-5.631068-02	.0	.0	.0
18	G	8.000676-03	-5.824678-02	-5.539491-02	.0	.0	.0
19	G	-2.970165-02	-5.828346-02	-2.117218-01	.0	.0	.0
20	G	-8.407594-03	-2.256113-01	-2.109185-01	.0	.0	.0
21	G	3.366880-02	-3.191812-01	-7.690203-02	.0	.0	.0
22	G	1.247221-02	-1.173368-01	-7.624082-02	.0	.0	.0
23	G	-3.202059-02	-1.173151-01	-2.623322-01	.0	.0	.0
24	G	-1.312326-02	-3.189575-01	-2.618314-01	.0	.0	.0
25	G	3.644662-02	-4.332005-01	-9.665431-02	.0	.0	.0
26	G	1.582748-02	-1.905973-01	-9.807861-02	.0	.0	.0
27	G	-3.327300-02	-1.905348-01	-3.085431-01	.0	.0	.0
28	G	-1.795811-02	-4.330999-01	-3.090712-01	.0	.0	.0

DAMAGE CRITERION = NONE

INCREMENTAL STIFFNESS 50 % LOADING SUBCASE 2

S T R E S S E S I N R O D E L E M E N T S (C T U B E) (LBS/SQ.IN.)

ELEMENT ID.	AXIAL STRESS	SAFETY MARGIN	TORSIONAL STRESS	SAFETY MARGIN	ELEMENT ID.	AXIAL STRESS	SAFETY MARGIN	TORSIONAL STRESS	SAFETY MARGIN
1	.0		.0		2	.0		.0	
3	.0		.0		4	.0		.0	
5	.0		.0		6	.0		.0	
7	2.095886+03	1.0+01	.0		8	-3.890512+02	4.8+01	.0	
9	-2.017964+03	8.5+00	.0		10	3.279128+02	7.2+01	.0	
11	-7.086355+02	1.7+01	.0		12	1.678001+03	8.5+00	.0	
13	2.006461+03	7.2+00	.0		14	-5.382429+02	2.3+01	.0	
15	1.017874+03	1.5+01	.0		16	-1.980322+03	5.5+00	.0	
17	-2.175370+03	5.1+00	.0		18	6.932344+02	2.3+01	.0	
19	1.999312+02	6.1+01	.0		20	-2.082070+02	4.6+01	.0	
21	-1.722111+02	5.6+01	.0		22	1.831870+02	6.6+01	.0	
23	-5.433204+02	7.9+01	.0		24	-6.413224+02	7.3+01	.0	
25	5.302805+02	1.0+02	.0		26	6.301366+02	9.6+01	.0	
27	-2.633026+00	8.7+03	.0		28	-9.525177+00	2.4+03	.0	
29	1.813031+03	1.3+01	.0		30	1.219843+02	2.0+02	.0	
31	-1.763800+03	1.0+01	.0		32	-1.512231+02	1.3+02	.0	
33	-8.734526+02	1.5+01	.0		34	1.928708+03	8.1+00	.0	
35	2.035907+03	7.8+00	.0		36	-1.089855+03	1.2+01	.0	
37	1.358321+03	1.2+01	.0		38	-2.407334+03	4.8+00	.0	
39	-2.150784+03	5.7+00	.0		40	1.193662+03	1.4+01	.0	
41	1.139936+02	1.2+02	.0		42	-2.189064+02	5.0+01	.0	
43	-1.065987+02	1.0+02	.0		44	2.103704+02	6.5+01	.0	
45	-5.997918+02	9.1+01	.0		46	-3.616479+02	1.7+02	.0	
47	5.855759+02	1.2+02	.0		48	3.425364+02	2.3+02	.0	
49	-3.765503+00	7.8+03	.0		50	-1.276120+01	2.3+03	.0	
51	1.379911+03	1.7+01	.0		52	7.144226+02	3.3+01	.0	
53	-1.321422+03	1.4+01	.0		54	-7.549249+02	2.5+01	.0	
55	-1.129183+03	1.2+01	.0		56	2.423532+03	6.8+00	.0	
57	2.173116+03	7.8+00	.0		58	-1.770916+03	7.7+00	.0	
59	1.714863+03	9.9+00	.0		60	-3.003300+03	4.0+00	.0	
61	-2.300082+03	5.7+00	.0		62	1.896380+03	9.2+00	.0	
63	1.488735+02	1.0+02	.0		64	-2.812774+02	4.3+01	.0	
65	-1.438065+02	8.5+01	.0		66	2.733373+02	5.6+01	.0	
67	-6.862996+02	1.0+02	.0		68	-3.145312+01	2.6+03	.0	
69	6.687827+02	1.3+02	.0		70	5.296387+00	2.0+04	.0	
71	-1.930908+00	2.0+04	.0		72	-1.962646+01	2.0+03	.0	
73	1.290318+03	2.5+01	.0		74	1.148172+03	2.9+01	.0	
75	-1.217862+03	2.1+01	.0		76	-1.201685+03	2.2+01	.0	
77	-1.595667+03	1.2+01	.0		78	3.062812+03	7.4+00	.0	
79	2.257876+03	1.1+01	.0		80	-2.185781+03	8.7+00	.0	
81	1.601493+03	1.5+01	.0		82	-3.063670+03	5.7+00	.0	
83	-2.390856+03	7.9+00	.0		84	2.339188+03	1.0+01	.0	
85	-7.093945+01	2.4+02	.0		86	-8.429602+01	2.0+02	.0	
87	7.717090+01	2.7+02	.0		88	7.137585+01	2.9+02	.0	
89	-7.953979+02	1.2+02	.0		90	-4.143457+01	2.6+03	.0	

DAMAGE CRITERION = NONE

INCREMENTAL STIFFNESS 50 % LOADING SUBCASE 2

S T R E S S E S   I N   R O D   E L E M E N T S   (C T U B E)   (LBS/SQ.IN.)

ELEMENT ID.	AXIAL STRESS	SAFETY MARGIN	TORSIONAL STRESS	SAFETY MARGIN	ELEMENT ID.	AXIAL STRESS	SAFETY MARGIN	TORSIONAL STRESS	SAFETY MARGIN
91	7.755576+02	1.5+02	.0		92	6.912109+00	2.0+04	.0	
93	-1.174805+00	4.3+04	.0		94	-2.545911+01	2.0+03	.0	
95	1.517651+03	3.0+01	.0		96	1.319505+03	3.4+01	.0	
97	-1.379430+03	2.6+01	.0		98	-1.431422+03	2.5+01	.0	
99	-1.824011+03	1.4+01	.0		100	3.491667+03	8.9+00	.0	
101	2.489045+03	1.3+01	.0		102	-2.443332+03	1.1+01	.0	
103	1.834190+03	1.8+01	.0		104	-3.495652+03	6.9+00	.0	
105	-2.663865+03	9.8+00	.0		106	2.617911+03	1.3+01	.0	
107	-5.250098+01	4.3+02	.0		108	-1.250378+02	1.8+02	.0	
109	1.144460+02	2.5+02	.0		110	5.255762+01	5.4+02	.0	
111	-9.194983+02	1.3+02	.0		112	-4.764453+01	3.0+03	.0	
113	8.875625+02	1.7+02	.0		114	-4.732910+00	3.1+04	.0	
115	6.586035+01	1.3+03	.0		116	-1.071396+02	6.2+02	.0	
117	1.850741+03	2.9+01	.0		118	1.287430+03	4.2+01	.0	
119	-1.343775+03	3.2+01	.0		120	-1.794080+03	2.4+01	.0	
121	-2.061425+03	1.5+01	.0		122	4.128576+03	9.2+00	.0	
123	3.055926+03	1.3+01	.0		124	-3.026574+03	1.1+01	.0	
125	2.094837+03	1.9+01	.0		126	-4.120793+03	7.2+00	.0	
127	-3.213598+03	1.0+01	.0		128	3.164576+03	1.3+01	.0	
129	-3.634321+02	7.6+01	.0		130	9.194763+01	3.8+02	.0	
131	-9.038428+01	3.1+02	.0		132	3.806885+02	9.1+01	.0	
133	-4.034072+02	4.0+02	.0		134	-2.479297+01	7.7+03	.0	
135	6.054766+02	3.3+02	.0		136	-1.595508+01	1.2+04	.0	
137	-1.985935+03	4.3+01	.0		138	2.078661+03	5.2+01	.0	

DAMAGE CRITERION = NONE

INCREMENTAL STIFFNESS 75 % LOADING SUBCASE 2

S T R E S S E S I N R O D E L E M E N T S (C T U B E) (LBS/SQ.IN.)

ELEMENT ID.	AXIAL STRESS	SAFETY MARGIN	TORSIONAL STRESS	SAFETY MARGIN	ELEMENT ID.	AXIAL STRESS	SAFETY MARGIN	TORSIONAL STRESS	SAFETY MARGIN
1	.0		.0		2	.0		.0	
3	.0		.0		4	.0		.0	
5	.0		.0		6	.0		.0	
7	3.180557+03	6.5+00	.0		8	-6.090774+02	3.0+01	.0	
9	-3.061034+03	5.2+00	.0		10	5.195061+02	4.5+01	.0	
11	-1.065306+03	1.1+01	.0		12	2.524473+03	5.3+00	.0	
13	3.029875+03	4.4+00	.0		14	-7.904973+02	1.6+01	.0	
15	1.525671+03	9.5+00	.0		16	-2.973785+03	3.3+00	.0	
17	-3.286572+03	3.0+00	.0		18	1.026750+03	1.5+01	.0	
19	2.991644+02	4.0+01	.0		20	-3.139926+02	3.0+01	.0	
21	-2.587820+02	3.7+01	.0		22	2.764727+02	4.3+01	.0	
23	-8.223837+02	5.2+01	.0		24	-9.852325+02	4.7+01	.0	
25	7.950940+02	6.7+01	.0		26	9.610486+02	6.2+01	.0	
27	-9.202881+00	2.5+03	.0		28	-1.660980+01	1.4+03	.0	
29	2.760029+03	7.9+00	.0		30	1.582844+02	1.5+02	.0	
31	-2.681496+03	6.3+00	.0		32	-1.976353+02	9.9+01	.0	
33	-1.311085+03	9.7+00	.0		34	2.900671+03	5.0+00	.0	
35	3.076049+03	4.9+00	.0		36	-1.619376+03	7.9+00	.0	
37	2.038528+03	7.6+00	.0		38	-3.617165+03	2.9+00	.0	
39	-3.248916+03	3.5+00	.0		40	1.776009+03	9.2+00	.0	
41	1.690861+02	8.1+01	.0		42	-3.286189+02	3.3+01	.0	
43	-1.606795+02	6.9+01	.0		44	3.153705+02	4.3+01	.0	
45	-9.082664+02	6.0+01	.0		46	-5.690024+02	1.1+02	.0	
47	8.772700+02	7.8+01	.0		48	5.263073+02	1.5+02	.0	
49	-1.266028+01	2.3+03	.0		50	-2.385867+01	1.2+03	.0	
51	2.106822+03	1.1+01	.0		52	1.046175+03	2.3+01	.0	
53	-2.013024+03	8.8+00	.0		54	-1.101124+03	1.7+01	.0	
55	-1.695562+03	7.8+00	.0		56	3.642226+03	4.2+00	.0	
57	3.287532+03	4.8+00	.0		58	-2.643214+03	4.8+00	.0	
59	2.577278+03	6.3+00	.0		60	-4.511325+03	2.3+00	.0	
61	-3.472183+03	3.5+00	.0		62	2.826793+03	5.8+00	.0	
63	2.245847+02	6.8+01	.0		64	-4.212401+02	2.8+01	.0	
65	-2.189875+02	5.6+01	.0		66	4.082813+02	3.7+01	.0	
67	-1.036204+03	6.9+01	.0		68	-7.672949+01	1.1+03	.0	
69	9.972158+02	9.0+01	.0		70	1.665448+01	6.3+03	.0	
71	-1.113945+01	3.4+03	.0		72	-3.766003+01	1.0+03	.0	
73	1.969708+03	1.6+01	.0		74	1.696032+03	1.9+01	.0	
75	-1.853718+03	1.4+01	.0		76	-1.769254+03	1.4+01	.0	
77	-2.396512+03	7.6+00	.0		78	4.599665+03	4.6+00	.0	
79	3.381771+03	6.8+00	.0		80	-3.265125+03	5.5+00	.0	
81	2.410217+03	9.7+00	.0		82	-4.602005+03	3.5+00	.0	
83	-3.611081+03	4.9+00	.0		84	3.495187+03	6.6+00	.0	
85	-1.065981+02	1.6+02	.0		86	-1.288651+02	1.3+02	.0	
87	1.133459+02	1.9+02	.0		88	1.070165+02	2.0+02	.0	
89	-1.200795+03	7.8+01	.0		90	-9.330469+01	1.2+03	.0	

DAMAGE CRITERION = NONE

INCREMENTAL STIFFNESS 75 % LOADING SUBCASE 2

S T R E S S E S I N R O D E L E M E N T S (C T U B E) (LBS/SQ.IN.)

ELEMENT ID.	AXIAL STRESS	SAFETY MARGIN	TORSIONAL STRESS	SAFETY MARGIN	ELEMENT ID.	AXIAL STRESS	SAFETY MARGIN	TORSIONAL STRESS	SAFETY MARGIN
91	1.156034+03	1.0+02	.0		92	1.558154+01	9.0+03	.0	
93	-1.186914+01	4.3+03	.0		94	-4.814172+01	1.1+03	.0	
95	2.309225+03	1.9+01	.0		96	1.956901+03	2.3+01	.0	
97	-2.091982+03	1.7+01	.0		98	-2.114908+03	1.7+01	.0	
99	-2.733761+03	9.1+00	.0		100	5.242883+03	5.6+00	.0	
101	3.757562+03	8.5+00	.0		102	-3.654515+03	6.8+00	.0	
103	2.761693+03	1.1+01	.0		104	-5.251874+03	4.3+00	.0	
105	-4.019805+03	6.2+00	.0		106	3.916175+03	8.2+00	.0	
107	-7.886230+01	2.9+02	.0		108	-1.914911+02	1.2+02	.0	
109	1.676157+02	1.7+02	.0		110	7.899951+01	3.6+02	.0	
111	-1.391391+03	8.7+01	.0		112	-1.073594+02	1.3+03	.0	
113	1.319391+03	1.1+02	.0		114	-1.064844+01	1.4+04	.0	
115	8.306836+01	1.0+03	.0		116	-1.760957+02	3.7+02	.0	
117	2.797051+03	1.9+01	.0		118	1.910486+03	2.8+01	.0	
119	-2.037488+03	2.1+01	.0		120	-2.669357+03	1.6+01	.0	
121	-3.087795+03	9.9+00	.0		122	6.204114+03	5.8+00	.0	
123	4.603016+03	8.5+00	.0		124	-4.536874+03	6.7+00	.0	
125	3.163083+03	1.2+01	.0		126	-6.186600+03	4.4+00	.0	
127	-4.846732+03	6.3+00	.0		128	4.736312+03	8.3+00	.0	
129	-5.380937+02	5.1+01	.0		130	1.379353+02	2.5+02	.0	
131	-1.344390+02	2.1+02	.0		132	5.770344+02	6.0+01	.0	
133	-5.291074+02	3.0+02	.0		134	-5.592969+01	3.4+03	.0	
135	9.844414+02	2.0+02	.0		136	-3.560937+01	5.6+03	.0	
137	-2.938574+03	2.9+01	.0		138	3.147651+03	3.4+01	.0	

TRUSS TAIL BOOM MODELS *** 13? ELEMENT VERSION
DAMAGE CRITERION = NONE

INCREMENTAL STIFFNESS 100% LOADING

SUBCASE 2

S T R E S S E S I N R O D E L E M E N T S (C T U B E) (LBS/SQ.IN.)

ELEMENT ID.	AXIAL STRESS	SAFETY MARGIN	TORSIONAL STRESS	SAFETY MARGIN	ELEMENT ID.	AXIAL STRESS	SAFETY MARGIN	TORSIONAL STRESS	SAFETY MARGIN
1	.0		.0		2	.0		.0	
3	.0		.0		4	.0		.0	
5	.0		.0		6	.0		.0	
7	4.290310+03	4.5+00	.0		8	-8.458912+02	2.2+01	.0	
9	-4.127390+03	3.6+00	.0		10	7.293166+02	3.2+01	.0	
11	-1.423472+03	8.0+00	.0		12	3.376294+03	3.7+00	.0	
13	4.066972+03	3.8+00	.0		14	-1.031504+03	1.2+01	.0	
15	2.032598+03	6.9+00	.0		16	-3.969805+03	2.2+00	.0	
17	-4.413740+03	2.0+00	.0		18	1.351614+03	1.1+01	.0	
19	3.979003+02	3.0+01	.0		20	-4.208998+02	2.2+01	.0	
21	-3.456797+02	2.8+01	.0		22	3.708930+02	3.2+01	.0	
23	-1.106693+03	5.8+01	.0		24	-1.344760+03	3.4+01	.0	
25	1.059840+03	5.0+01	.0		26	1.302639+03	4.6+01	.0	
27	-1.935426+01	1.2+03	.0		28	-2.523804+01	9.0+02	.0	
29	3.734626+03	5.6+00	.0		30	1.783222+02	1.4+02	.0	
31	-3.623606+03	4.4+00	.0		32	-2.247424+02	8.7+01	.0	
33	-1.749367+03	7.0+00	.0		34	3.878163+03	3.5+00	.0	
35	4.131343+03	3.4+00	.0		36	-2.138730+03	5.7+00	.0	
37	2.719465+03	5.4+00	.0		38	-4.831562+03	1.9+00	.0	
39	-4.362564+03	2.3+00	.0		40	2.348850+03	6.7+00	.0	
41	2.228667+02	6.1+01	.0		42	-4.385020+02	2.5+01	.0	
43	-2.152928+02	5.1+01	.0		44	4.202727+02	3.2+01	.0	
45	-1.222733+03	4.4+01	.0		46	-7.941973+02	7.6+01	.0	
47	1.168376+03	5.8+01	.0		48	7.184955+02	1.1+02	.0	
49	-2.633716+01	1.1+03	.0		50	-3.809613+01	7.7+02	.0	
51	2.858908+03	7.6+00	.0		52	1.361091+03	1.7+01	.0	
53	-2.725686+03	6.2+00	.0		54	-1.426571+03	1.3+01	.0	
55	-2.263349+03	5.6+00	.0		56	4.866162+03	2.9+00	.0	
57	4.421090+03	3.3+00	.0		58	-3.507026+03	3.4+00	.0	
59	3.443265+03	4.4+00	.0		60	-6.024208+03	1.5+00	.0	
61	-4.659512+03	2.5+00	.0		62	3.745650+03	4.2+00	.0	
63	3.011299+02	5.0+01	.0		64	-5.607360+02	2.1+01	.0	
65	-2.961062+02	4.1+01	.0		66	5.421022+02	2.8+01	.0	
67	-1.393809+03	5.1+01	.0		68	-1.418672+02	5.7+02	.0	
69	1.321798+03	6.8+01	.0		70	3.388843+01	3.1+03	.0	
71	-2.607666+01	1.5+03	.0		72	-6.115771+01	6.3+02	.0	
73	2.672370+03	1.2+01	.0		74	2.226468+03	1.4+01	.0	
75	-2.507915+03	9.9+00	.0		76	-2.314683+03	1.1+01	.0	
77	-3.199837+03	5.4+00	.0		78	6.140916+03	3.2+00	.0	
79	4.543046+03	4.[illegible]+00	.0		80	-4.335938+03	3.9+00	.0	
81	3.224751+03	7.0+00	.0		82	-6.145446+03	2.3+00	.0	
83	-4.843582+03	3.4+00	.0		84	4.642612+03	4.7+00	.0	
85	-1.4241[illegible]+02	1.2+02	.0		86	-1.750981+02	9.6+01	.0	
87	1.473870+02	1.4+02	.0		88	1.426525+02	1.5+02	.0	
89	-1.6114[illegible]+03	5.[illegible]+01	.0		90	-1.661094+02	6.5+02	.0	

DAMAGE CRITERION = NONE

INCREMENTAL STIFFNESS _ 100% LOADING SUBCASE 2

S T R E S S E S   I N   R O D   E L E M E N T S   (C T U B E)   (LBS/SQ.IN.)

ELEMENT ID.	AXIAL STRESS	SAFETY MARGIN	TORSIONAL STRESS	SAFETY MARGIN	ELEMENT ID.	AXIAL STRESS	SAFETY MARGIN	TORSIONAL STRESS	SAFETY MARGIN
91	1.531721+03	7.6+01	.0		92	2.777783+01	5.0+03	.0	
93	-2.941113+01	1.7+03	.0		94	-7.744897+01	6.5+02	.0	
95	3.123028+03	1.4+01	.0		96	2.579405+03	1.7+01	.0	
97	-2.820045+03	1.2+01	.0		98	-2.776889+03	1.2+01	.0	
99	-3.656088+03	6.5+00	.0		100	6.998632+03	3.9+00	.0	
101	5.043096+03	6.1+00	.0		102	-4.859465+03	4.9+00	.0	
103	3.696921+03	8.3+00	.0		104	-7.014665+03	2.9+00	.0	
105	-5.392645+03	4.3+00	.0		106	5.208050+03	5.9+00	.0	
107	-1.053232+02	2.1+02	.0		108	-2.605734+02	8.6+01	.0	
109	2.180469+02	1.3+02	.0		110	1.055802+02	2.7+02	.0	
111	-1.871523+03	6.4+01	.0		112	-1.911719+02	7.4+02	.0	
113	1.743232+03	8.6+01	.0		114	-1.892187+01	7.8+03	.0	
115	8.967383+01	9.2+02	.0		116	-2.553506+02	2.6+02	.0	
117	3.757447+03	1.4+01	.0		118	2.519782+03	2.1+01	.0	
119	-2.745965+03	1.5+01	.0		120	-3.530040+03	1.2+01	.0	
121	-4.112268+03	7.2+00	.0		122	8.288303+03	4.1+00	.0	
123	6.163988+03	6.1+00	.0		124	-6.046208+03	4.8+00	.0	
125	4.246366+03	8.9+00	.0		126	-8.257161+03	3.1+00	.0	
127	-6.498541+03	4.4+00	.0		128	6.301957+03	6.0+00	.0	
129	-7.079434+02	3.9+01	.0		130	1.838745+02	1.9+02	.0	
131	-1.776914+02	1.6+02	.0		132	7.773601+02	4.4+01	.0	
133	-6.038027+02	2.8+02	.0		134	-9.966016+01	1.9+03	.0	
135	1.414676+03	1.4+02	.0		136	-6.313672+01	3.2+03	.0	
137	-3.863580+03	2.2+01	.0		138	4.235999+03	2.5+01	.0	

* 57.8 CPU-S 266.3 COR-S 1345 ELP-S. 158 OFP END

* 57.9 CPU-S 266.3 COR-S 1345 ELP-S. 179 EXIT BEGN

APPENDIX D

Element Identification Table for All Models

Type	Element ID	Node-Node	Type	Element ID	Node-Node
Vertical	1	1-2	Vertical	25	7-8
Horizontal	2	1-4	Horizontal	26	6-7
Vertical	3	3-4	Transverse	27	5-7
Horizontal	4	2-3	Diagonals	28	6-8
Transverse	5	1-3	Longerons	29	5-9
Diagonals	6	2-4	"	30	6-10
Longerons	7	1-5	"	31	7-11
"	8	2-6	"	32	8-12
"	9	3-7	Outside	33	5-10
"	10	4-8	Diagonals	34	6-9
Outside	11	1-6	"	35	5-12
Diagonals	12	2-5	"	36	8-9
"	13	1-8	"	37	8-11
"	14	4-5	"	38	7-12
"	15	4-7	"	39	6-11
"	16	3-8	"	40	7-10
"	17	2-7	Interior	41	5-11
"	18	3-6	Diagonals	42	6-12
Interior	19	1-7	"	43	7-9
Diagonals	20	2-8	"	44	8-10
"	21	3-5	Vertical	45	9-10
"	22	4-6	Horizontal	46	9-12
Vertical	23	5-6	Vertical	47	11-12
Horizontal	24	5-8	Horizontal	48	10-11

Type	Element ID	Node-Node	Type	Element ID	Node-Node
Transverse	49	9-11	Diagonals	80	16-17
Diagonals	50	10-12	"	81	16-19
Longerons	51	9-13	"	82	15-20
"	52	10-14	"	83	14-19
"	53	11-13	"	84	15-18
"	54	12-16	Interior	85	13-19
Outside	55	9-14	Diagonals	86	14-20
Diagonals	56	10-13	"	87	15-17
"	57	9-16	"	88	16-18
"	58	12-13	Vertical	89	17-18
"	59	12-15	Horizontal	90	17-20
"	60	11-16	Vertical	91	19-20
"	61	10-15	Horizontal	92	18-19
"	62	11-14	Transverse	93	17-19
Interior	63	9-15	Diagonals	94	18-20
Diagonals	64	10-16	Longerons	95	17-21
"	65	11-13	"	96	18-22
"	66	12-14	"	97	19-23
Vertical	67	13-14	"	98	20-24
Horizontal	68	13-16	Outside	99	17-22
Vertical	69	15-16	Diagonals	100	18-21
Horizontal	70	14-15	"	101	17-24
Transverse	71	13-15	"	102	20-21
Diagonals	72	14-16	"	103	20-23
Longerons	73	13-17	"	104	19-24
Longerons	74	14-18	"	105	18-23
"	75	15-19	"	106	19-22
"	76	16-20	Interior	107	17-23
Outside	77	13-18	Diagonals	108	18-24
Diagonals	78	14-17	"	109	19-21
"	79	13-20	"	110	20-22

Type	Element ID	Node-Node
Vertical	111	21-22
Horizontal	112	21-24
Vertical	113	23-24
Horizontal	114	22-23
Transverse	115	21-23
Diagonals	116	22-24
Longerons	117	21-25
"	118	22-26
"	119	23-27
"	120	24-28
Outside	121	21-26
Diagonals	122	22-25
"	123	21-28
Diagonals	124	24-25
"	125	24-27
"	126	23-28
"	127	22-27
"	128	23-26
Interior	129	21-27
Diagonals	130	22-28
"	131	23-25
"	132	24-26
Vertical	133	25-26
Horizontal	134	25-28
Vertical	135	27-28
Horizontal	136	26-27
Transverse	137	25-27
Diagonals	138	26-28*
*Note models 2 & 3 end 138		
Longerons	139	25-29
"	140	26-30
"	141	27-31

Type	Element ID	Node-Node
Longerons	142	28-32
Outside	143	25-30
Diagonals	144	26-29
"	145	25-32
"	146	28-29
"	147	28-31
"	148	27-32
"	149	26-31
"	150	27-30
Interior	151	25-31
Diagonals	152	26-32
"	153	27-29
"	154	28-30
Vertical	155	29-30
Horizontal	156	29-32
Vertical	157	31-32
Horizontal	158	30-31
Transverse	159	29-31
Diagonals	160	30-32
Longerons	161	29-33
"	162	30-34
"	163	31-35
"	164	32-36
Outside	165	29-34
Diagonals	166	30-33
"	167	29-36
"	168	32-33
"	169	32-35
"	170	31-36
"	171	3-35
"	172	31-34
Interior	173	29-35

Type	Element ID	Node-Node	Type	Element ID	Node-Node
Diagonals	174	30-36	Longerons	206	38-42
"	175	31-33	"	207	39-43
"	176	32-34	"	208	40-44
Vertical	177	33-34	Outside	209	37-42
Horizontal	178	33-36	Diagonals	210	38-41
Vertical	179	35-36	"	211	37-44
Horizontal	180	34-35	"	212	40-41
Transverse	181	33-35	"	213	40-43
Diagonals	182	34-36	"	214	39-44
Longerons	183	33-37	"	215	38-43
"	184	34-38	"	216	39-42
"	185	35-39	Interior	217	37-43
"	186	36-40	Diagonals	218	38-44
Outside	187	33-38	"	219	39-41
Diagonals	188	34-37	"	220	40-42
"	189	33-40	Vertical	221	41-42
"	190	36-37	Horizontal	222	41-44
"	191	36-39	Vertical	223	43-44
"	192	35-40	Horizontal	225	42-43
"	193	34-39	Transverse	225	41-43
"	194	35-38	Diagonals	226	42-44
Interior	195	33-39			
Diagonals	196	34-40			
"	197	35-37			
"	198	36-38			
Vertical	199	37-38			
Horizontal	200	37-40			
ertical	201	39-40			
Horizontal	202	38-39			
Transverse	203	37-39			
Diagonals	204	38-40			
Longerons	205	37-41			

Appendix E

Grid Point Locations Model 1

Point #	X	Y	Z
1	.000	12.300	13.300
2	.000	12.100	-11.500
3	.000	-11.400	-11.500
4	.000	-11.600	13.300
5	23.700	11.300	12.300
6	23.900	11.100	-10.700
7	23.900	-10.600	-10.700
8	23.750	-10.800	12.300
9	45.950	10.400	11.300
10	45.950	10.200	-9.900
11	45.950	-9.800	-9.900
12	45.950	-10.000	11.300
13	66.400	9.500	10.500
14	66.500	9.300	-9.200
15	66.500	-9.100	-9.200
16	66.400	-9.300	10.500
17	85.400	8.800	9.700
18	85.400	8.600	-8.600
19	85.400	-8.400	-8.600
20	85.400	-8.600	9.700
21	103.000	8.000	8.900
22	103.000	7.900	-8.000
23	103.000	-7.800	-8.000
24	103.000	-8.000	8.900
25	119.300	7.400	8.300
26	119.300	7.200	-7.400
27	119.300	-7.300	-7.400
28	119.300	-7.500	8.300
29	134.400	6.700	7.600

Appendix E (continued)

Point #	X	Y	Z
30	134.500	6.600	-6.900
31	134.500	-6.800	-6.900
32	134.400	-6.900	7.600
33	148.500	6.100	7.000
34	148.500	6.000	-6.500
35	148.500	-6.300	-6.500
36	148.500	-6.400	7.000
37	161.400	5.600	6.500
38	161.500	5.500	-6.000
39	161.500	-5.800	-6.000
40	161.400	-6.000	6.500
41	173.500	5.100	6.000
42	173.500	5.000	-5.600
43	173.500	-5.400	-5.600
44	173.500	-5.500	6.000

Appendix F

Grid Point Locations Models 2 and 3

Point #	X	Y	Z
1	.000	11.95	12.375
2	.000	11.75	-12.375
3	.000	-11.75	-12.375
4	.000	-11.95	12.375
5	33.5	10.666	11.105
6	33.5	10.485	-11.105
7	33.5	-10.485	-11.105
8	33.5	-10.666	11.105
9	66.5	9.401	9.855
10	66.5	9.239	-9.855
11	66.5	-9.239	-9.855
12	66.5	-9.401	9.855
13	99.5	8.136	8.604
14	99.5	7.994	-8.604
15	99.5	-7.994	-8.604
16	99.5	-8.136	8.604
17	127.5	7.063	7.543
18	127.5	6.937	-7.543
19	127.5	-6.937	-7.543
20	127.5	-7.063	7.543
21	151.5	6.143	6.634
22	151.5	6.031	-6.634
23	151.5	-6.031	-6.634
24	151.5	-6.143	6.634
25	173.5	5.3	5.8
26	173.5	5.2	-5.8
27	173.5	-5.2	-5.8
28	173.5	-5.3	5.800

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